AD NUMBER
ADC020353
CLASSIFICATION CHANGES
TO: unclassified
FROM: confidential
LIMITATION CHANGES
TO: Approved for public release, distribution unlimited
FROM: Distribution: Further dissemination only as directed by Commanding Officer, Naval Ocean Research and Development Activity, Attn: Code 520, NSTL Station, MS 39529, FEB 1979, or higher DoD authority.
AUTHORITY
ONR ltr, 31 Jan 2006; ONR ltr, 31 Jan 2006

CONFIDENTIAL

(14) NORDA TECHNICAL NOTE 44
TN-44

LEVEL II

ENVIRONMENTAL VARIABILITY DURING THE CHURCH STROKE II CRUISE 5 EXERCISE (U)

(10) PAUL J. BUCCA

(8)

(9) Final rept. 9 Nov–16 Dec 77 (12) 61

Ocean Acoustics Division

Naval Oceanographic Laboratory

(16) AR0119

February 1979 (17) AR011930D

Prepared for

LONG RANGE ACOUSTIC PROPAGATION PROJECT

Further Dissemination Only As Directed by NORDA Code 520

NAVAL OCEAN RESEARCH AND DEVELOPMENT ACTIVITY

NSTL Station, Mississippi 39529

CONFIDENTIAL

392 773 LB

DISCLAIMER NOTICE

THIS DOCUMENT IS BEST QUALITY PRACTICABLE. THE COPY FURNISHED TO DDC CONTAINED A SIGNIFICANT NUMBER OF PAGES WHICH DO NOT REPRODUCE LEGIBLY.

EXECUTIVE SUMMARY (U)

(C) During the period 9 November through 16 December 1977, 160 XBTs and 127 AXBTs were deployed during Cruise 5 of the CHURCH STROKE II Exercise in the Philippine Sea. The environmental data collection effort was centered around the exercise baseline (12°-20°N along 132°E) and at various acoustic sites along this track. In addition, oceanographic data were collected along an acoustic projector tow located in the vicinity of the southern end of the Ryukyu Island arc. AXBT probes were deployed by the Oceanographic Development Squadron Eight (VXN-8) aircraft throughout these areas to coincide with acoustic events.

(U) OCEANOGRAPHIC FINDINGS

(U) Typhoon Lucy, a storm which packed sustained winds of 120 mph, had only a minimal effect on the sound speed structure along the baseline as late as 2-1/2 days after its passage. The lack of observed variability may have resulted from the mixing generated by the passage of three previous typhoons and one tropical storm in four months and the relaxation time prior to the post-storm data sampling.

(U) The most marked effect of the typhoon passage was in the persistency of the sonic layer after its passage as compared to the pre-storm analysis.

(U) Sound speed variation in the thermocline area exceeded 21.5 m/sec between Sites ES and EN owing to an upwelling center located south of the exercise baseline.

(U) ACOUSTIC IMPLICATIONS

(C) The absence of marked oceanographic variability resulting from the typhoon passage should reflect only a minimal effect on acoustic propagation.

(C) The passage of a major typhoon over a moored receiver provides an opportunity to study the differences between near field and distant ambient noise spectra.

(C) Depth excess is adequate for convergence zone propagation from a near-surface source from the LAMBDA array toward sites ES and EN located to the south and the north of the receiver, respectively. However, the extension of the Undaneta Ridge into the sound channel between the receiver and portions of the USS BEAUFORT projector tow to the northwest may preclude reliable acoustic path propagation.

ACKNOWLEDGEMENTS (U)

(U) This work was sponsored by the Long Range Acoustic Propagation Project (LRAPP). The data collecting effort performed by personnel aboard the three exercise vessels and VXN-8 aircraft are greatly appreciated. Mr. W.C. Lippert of NORDA Code 341 was instrumental in the navigation rectification of all exercise platforms and the conversion of the temperature data to sound speed. Mr. Elwyn Graham of the DANALYT Corporation is thanked for his aid in supplying a statistically analyzed historical salinity data base tailored to the author's requirements.

CONTENTS (U)

ILLUSTRATIONS (U)

TABLES (U)

I. (C) INTRODUCTION

(C) The CHURCH STROKE II Cruise 5 exercise was conducted in the Philippine Sea during November and December 1977. Phase One took place from 9 to 23 November and Phase Two was executed from 23 November to 16 December. This report provides an analysis of Phase One environmental data only, since the data base collected during Phase Two (four expendable bathythermograph observations) is inadequate. This exercise was sponsored by the Chief of Naval Operations (OP-095) and was conducted under the direction of Commander-in-Chief, U.S. Pacific Fleet (CINCPACFLT). The program is under the general technical supervision of the Long Range Propagation Project (LRAPP) of the Naval Ocean Research and Development Activity (NORDA). NORDA Code 341 has been funded to analyze and report the non-acoustic data collected during the exercise. A detailed description of the exercise is given in the Exercise Plan for CHURCH STROKE Two, Cruise 5, Long Range Acoustic Propagation Project (1977).

II. (C) DISCUSSION OF ENVIRONMENTAL DATA

A. (U) DATA DISTRIBUTION

(U) The oceanographic environment in the exercise area was sampled primarily by the shipboard Expendable Bathythermograph (XBT) and the Airborne Expendable Bathythermograph (AXBT). Figure 1 shows the positions of 160 XBTs deployed by the three exercise vessels, and Figure 2 shows the locations of the 127 AXBTs deployed by the Oceanographic Development Squadron Eight (VXN-8) RP3A Orion aircraft.

(C) Figure 3 depicts the operational portions of the tracks occupied by the exercise vessels superimposed on the surface current regime. M/V SEISMIC EXPLORER towed the LAMBDA acoustic array and focused its data collection effort in the vicinity of Site E. The M/V INDIAN SEAL deployed XBT probes along the exercise baseline (130°E from 12°-20°N), and was responsible for towing an HX-373 projector and implanting various acoustic and meteorological systems. The environmental data were collected by USS BEAUFORT during an HX-231F projector tow along various tracks that were either radial or broadside to LAMBDA at site E (those track segments labeled "HX"). The VXN-8 aircraft deployed AXBT probes during six sorties at various locations and at times which were coincidental with acoustic measurements. In areas of AXBT deployment, the VXN-8 aircraft collected sea surface temperature data measured via an Airborne Radiation Thermometer (ART) to determine the areal extent of any oceanographic fronts which might have existed in the exercise area. In addition, laser wave height profilometer data and sea surface photographs were taken along large portions of each track to determine the effect of wind-generated ambient noise during the exercise. The wave height and photographic data are not reported in this document. Illustrations and tables of the exercise vessels' rectified navigation are located in Appendix A.

B. (U) DATA TREATMENT AND RELATIVE DATA ACCURACY

(U) The XBT and AXBT data were recorded as analog records. These records were visually quality checked and digitized on magnetic tape using an ALTEK Model AC-90 digitizer. The data set, which contains temperature vs. depth pairs, was visually checked to guarantee the quality of the digitized output.

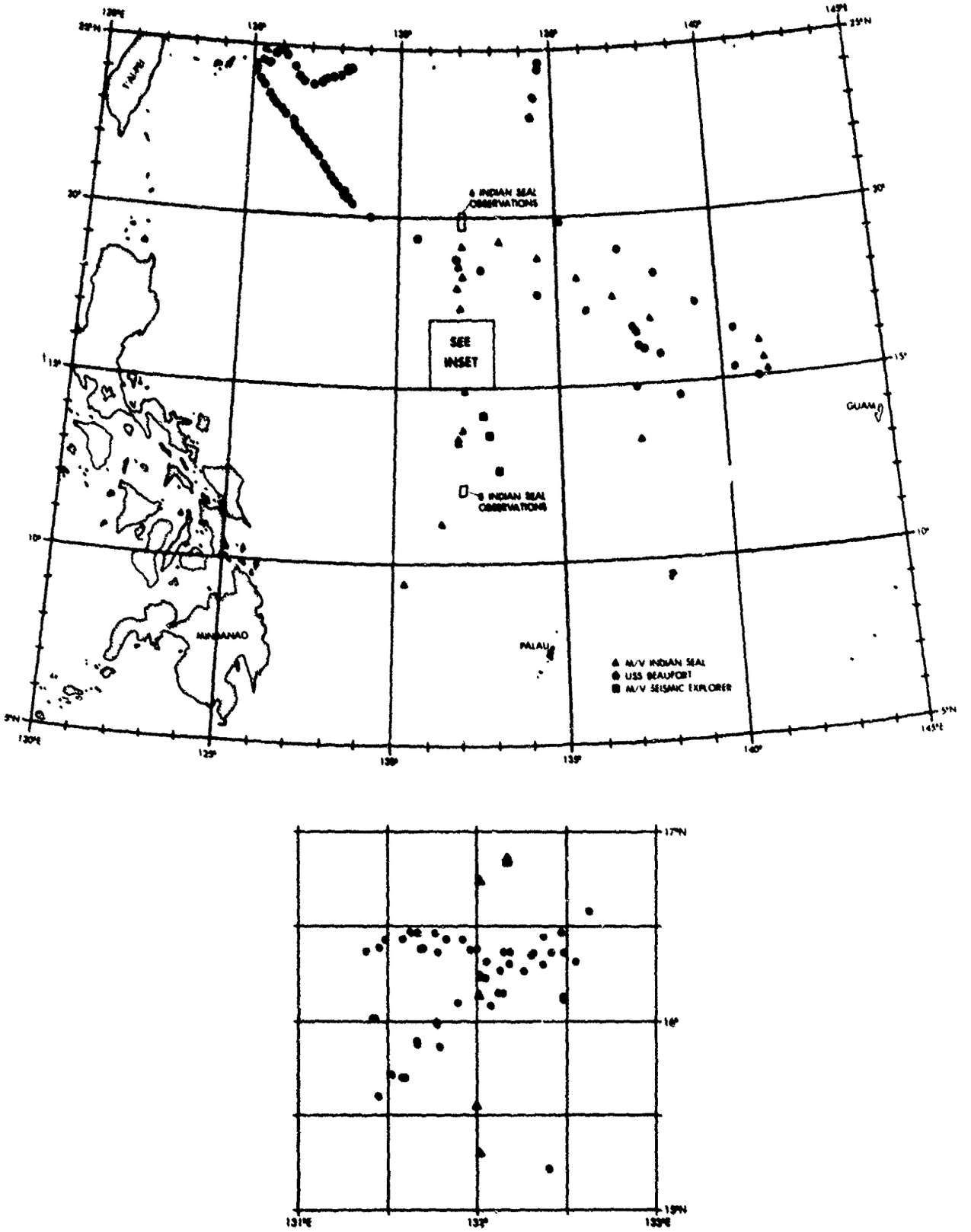


Figure 1 (C). Location of XBT data taken by exercise vessels (U)

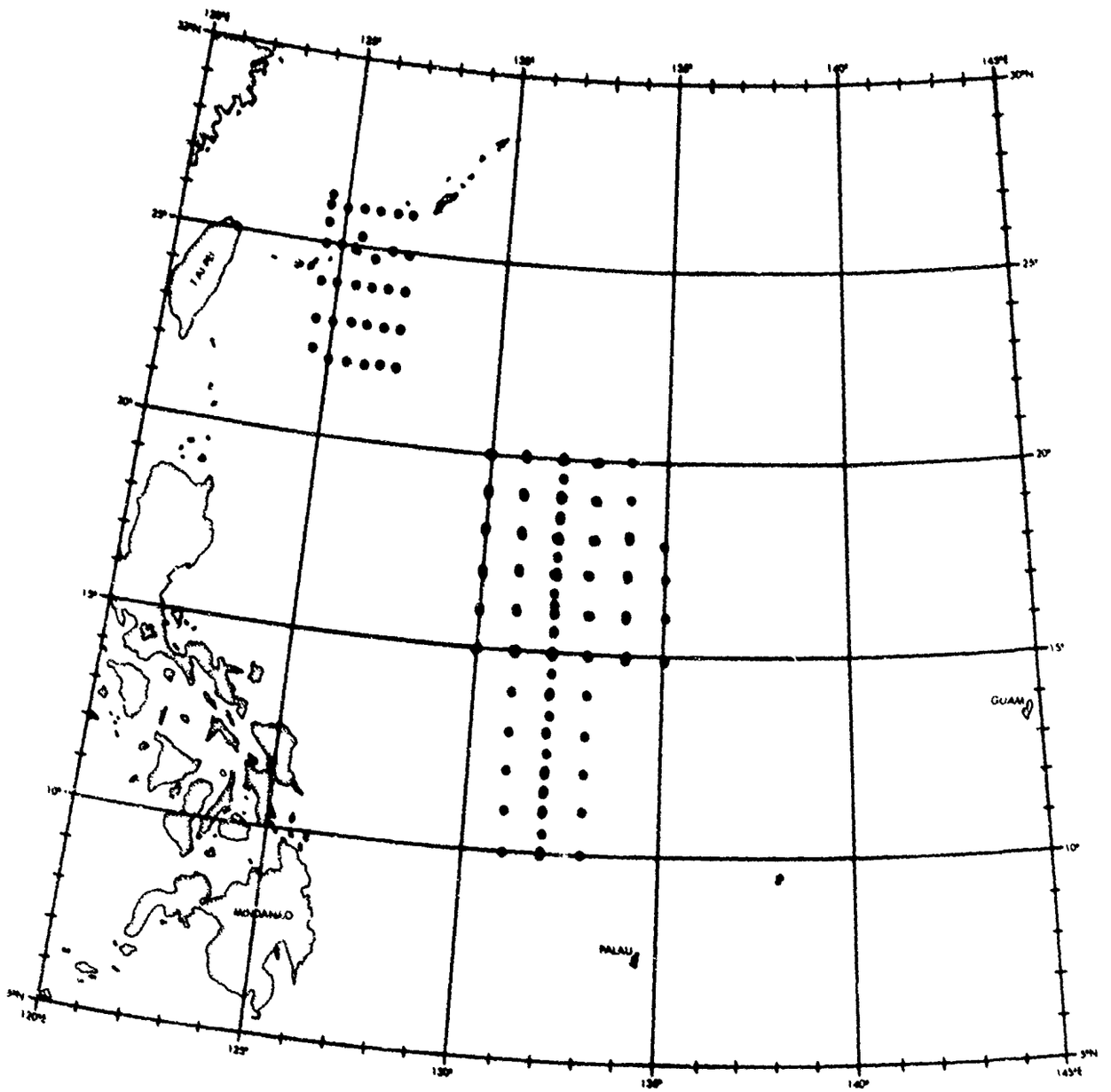


Figure 2 (C). Location of AXBT data taken by VXN-8 aircraft (U)

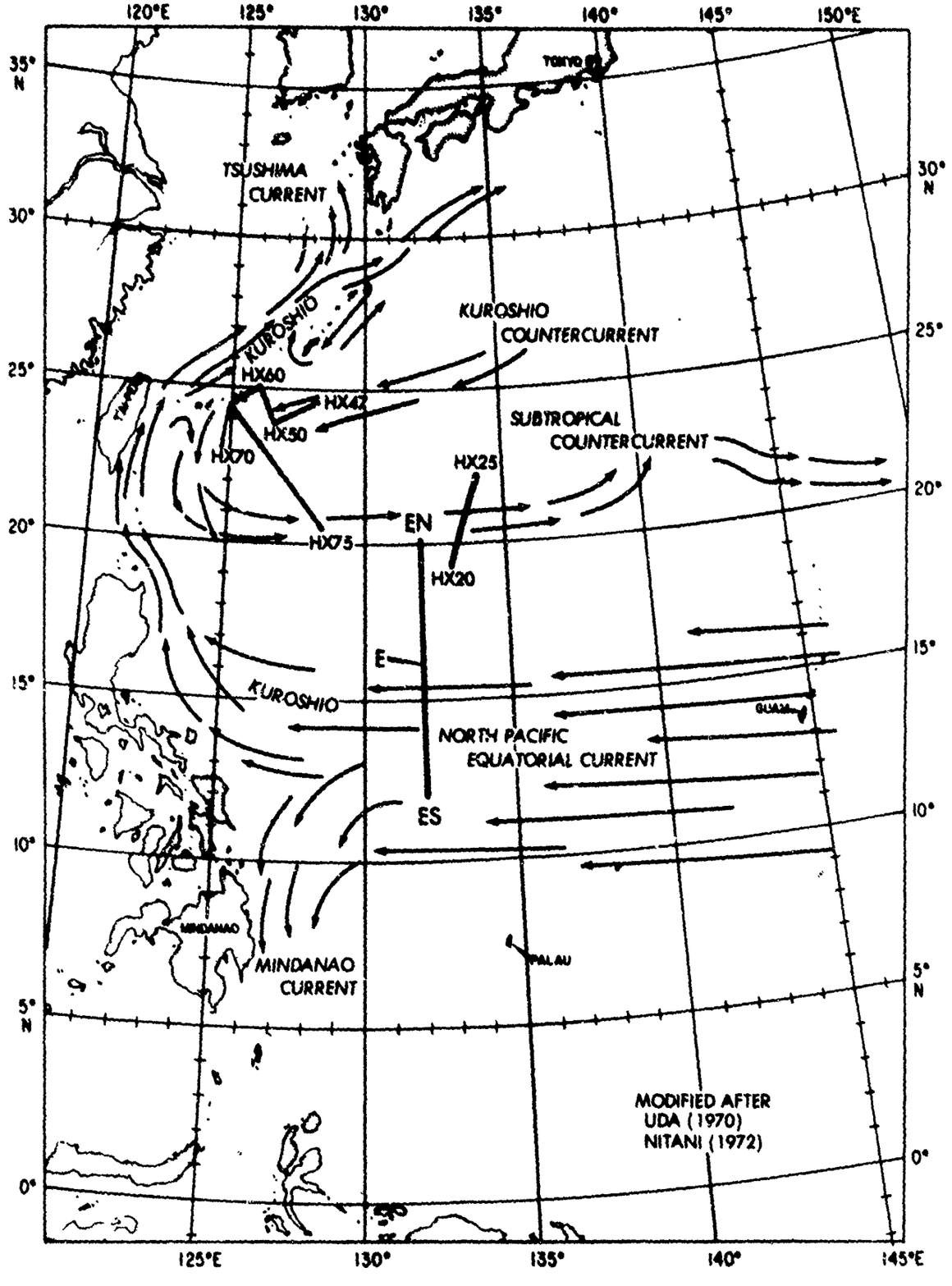


Figure 3 (C). Generalized circulation in the exercise area (U)

(U) Historical salinity values, used to convert the temperature-depth data to sound speed, were obtained from the LRAPP data bank. Composites of salinity profiles were plotted in ten unique oceanographic regimes and compared to the numerical mean profile. The salinity profile that most closely resembled the mean was used as the model to convert all temperature data in that regime to sound speed. All sound speed values were calculated from the equation of Wilson (1960).

(U) The XBT probe has an accuracy of about $\pm$ 0.2°C, which results in a calculated sound speed accuracy of about $\pm$ 0.7 m/sec (1.4 m/sec extreme spread), assuming that approximate salinities are chosen. Additional error is introduced which results from inaccuracies in Wilson's equation; however, the primary source of error is attributed to the temperature resolution accuracy of the XBT probe. The extreme variation in sound speed of all probes that extended to 2000 m was 1.7 m/sec. The 0.3 m/sec variation between the extreme spread of the instrument and that observed can be accounted for by environmental variation. An average sound speed of 1491.5 m/sec at 2000 m depth as calculated from the XBT data agrees well with the historical average (1491.2 m/sec) as derived from hydrocast data.

III. (U) OCEANOGRAPHIC SETTING

(U) The surface currents, as depicted in Figure 3, indicate that the exercise area in the vicinity of Site E south to Site ES is occupied by the North Pacific Equatorial Current. The Kuroshio Current, whose source waters emanate from the North Pacific Equatorial Current, flows to the west of the Ryukyu Island arc and exerts only a minimal effect in the exercise area. Uda (1969) indicates that the eastward-flowing Subtropical Countercurrent lies between 20° and 24°N in the exercise area and extends to a depth of approximately 300 m. The Subtropical Convergence, as described by Uda (1955), lies to the north of and is parallel to the Subtropical Countercurrent, and separates the Subtropical Mode Water to the north from the tropical waters to the south. Subtropical Mode Water is characterized by an isothermal layer and water of approximately 18°C that is present between 150 and 300 m depth, and is capable of producing secondary sound channel structures. The Kuroshio Countercurrent contains Kuroshio Water as it exists south of Japan and represents the only relatively cool water in the exercise area.

IV. (U) METEOROLOGICAL VARIABILITY DURING THE EXERCISE

(U) Meteorological conditions played a very large role during the exercise. The entry of Typhoon Lucy into the exercise area between Guam and Palau caused a suspension of the exercise from 1 to 7 December. Figures 4 and 5 show the positions and wind speeds associated with Lucy every 12 hours (except for 060000Z) while it was located in the exercise area.

(U) Lucy entered the Philippine Sea classified as a tropical storm (maximum sustained winds of at least 34 kn) and was upgraded to a typhoon (maximum sustained winds of at least 64 kn) at 030000Z December, very soon after the eye passed the vicinity of Site ES. Maximum wind speeds were obtained (120 kn sustained winds with gusts to 145 kn) at 040000Z December just prior to its northward excursion. After proceeding to the north, then in an easterly direction,

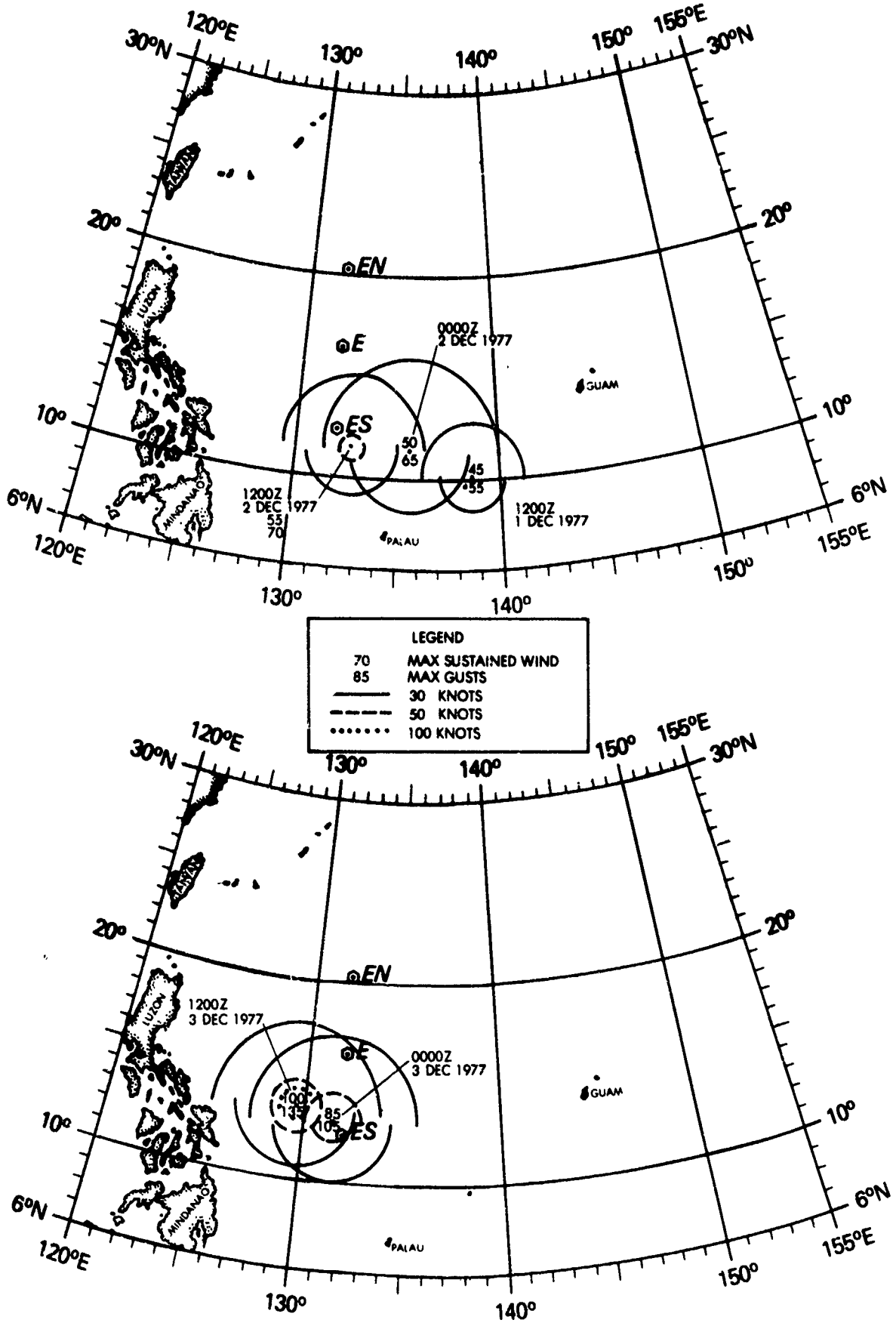


Figure 4 (C). Wind speeds in exercise area (011200Z Dec — 031200Z Dec 1977)(U)

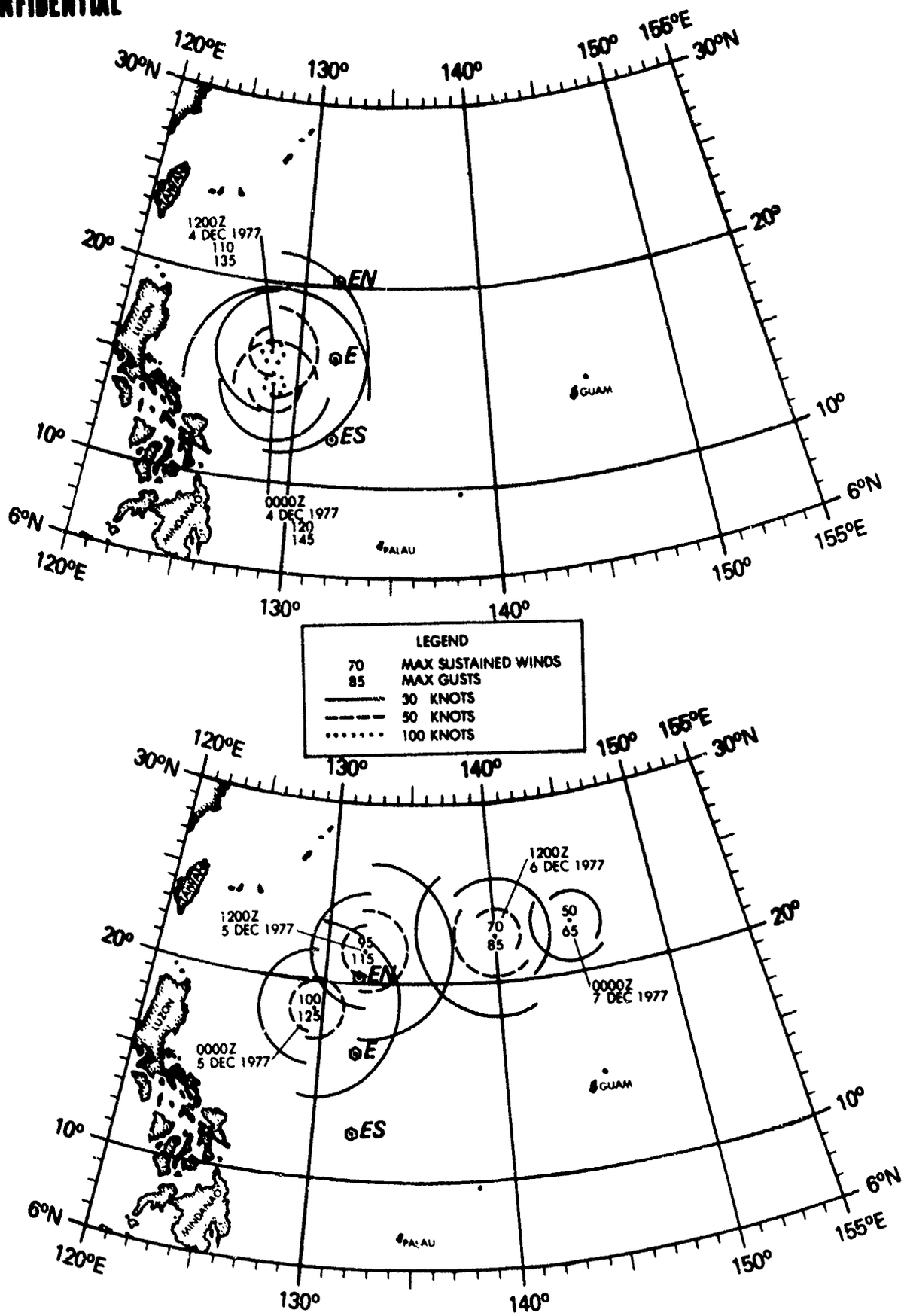


Figure 5 (C). Wind speeds in exercise area (040000Z Dec — 070000Z Dec 1977) (U)

cold air entrainment and the presence of the upper atmospheric jet stream caused, respectively, a weakening (subsequent downgrading to tropical storm at 061800Z December) and an acceleration of the storm center. Figure 6 presents an areal contour chart of wind speeds as they affected the exercise area during Lucy's tenure in the Philippine Sea. Caution must be used in interpreting this illustration, since it is constructed from the radii circles (as obtained from reconnaissance flights) on the two previous figures and not from actual measurement grids. Nevertheless, it presents a coarse depiction of the areas that were most affected by Typhoon Lucy; i.e., those directions from which wind-generated ambient noise values would potentially be the greatest with respect to the moored receivers. The passage of a storm of this magnitude proximate to the ACODACS should offer an excellent opportunity to study the characteristics of both locally generated and distant sources of ambient noise.

V. (U) SOUND SPEED VARIABILITY ALONG THE EXERCISE BASELINE

(C) Oceanographic variability along the baseline was measured at the beginning of the exercise (pre-storm) and toward the end of the exercise (post-storm) by both ship and aircraft. Figure 7 shows a contoured sound speed section and composite of selected profiles along the 132°E baseline from Site EN (beginning 270600Z November) to Site ES (ending 301801Z November) that were collected by M/V INDIAN SEAL. The first effects of then Tropical Storm Lucy were experienced at Site ES between 011200Z December and 020000Z December. Figure 8 presents a similar sound speed section and composite along the baseline taken by VXN-8 on 8 December, six days after Lucy passed over Site ES, and two and one-half days after it achieved its closest point of approach to Site EN. Figure 9 presents a comparison of selected sound speed contours, sonic layer and critical depth positions extracted from Figures 7 and 8.

(C) Comparisons of these sections indicate that variability of the oceanographic environment resulting from the passage of Typhoon Lucy at the times of these measurements was minimal. The upper 400 m of the sea surface north of approximately 17°30'N appeared to have been altered more than the baseline to the south of 17° 30'N. This can be explained by the relatively short time between the storm's passage and when the measurements were made (relaxation time), and its stronger intensity at Site EN as compared to that at ES. North of 17°30'N, for instance, the sonic layer depth prior to the typhoon averaged 62 m; after the storm, the sonic layer had deepened to 75 m, while there was no perceptible change in this parameter south of 17°30'N. The sonic layer along the entire baseline became much more uniform after the passage of the typhoon as compared to its existence prior to the storm. However, the most apparent aspect of the near-surface structure is the relatively deep layer depth which existed prior to Lucy. It is probable that a layer of this magnitude might have been created by three previous typhoons and one tropical storm which had traversed this area in the preceding four months. The occurrence of these prior disturbances could have created sufficient mixing of the upper water column so as to minimize the effects that Lucy might have exerted. Since the oceanographic environment was not markedly affected, the effects of the storm on sound propagation should have been minimal.

(C) Sound speed values below the sonic layer were affected by only small displacements of isolines. Figure 9 shows that the 1520 m/sec isoline was found to be shallower in the water column (due to cooler temperatures) after the storm passage, especially north of 17°30'N where relaxation times were shorter and the storm was more intense. Variations in critical depth (in this instance, a

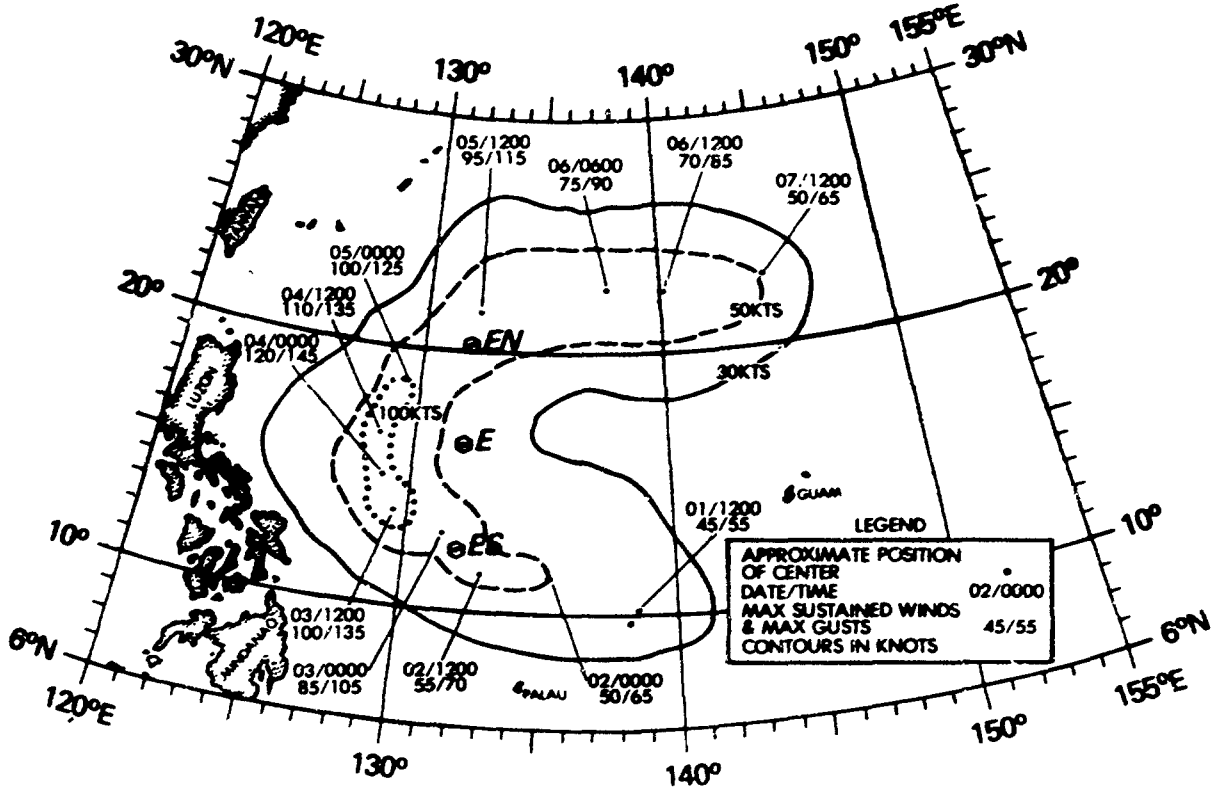


Figure 6 (C). Areal contours of wind speed during the storm's tenure in the exercise area (U)

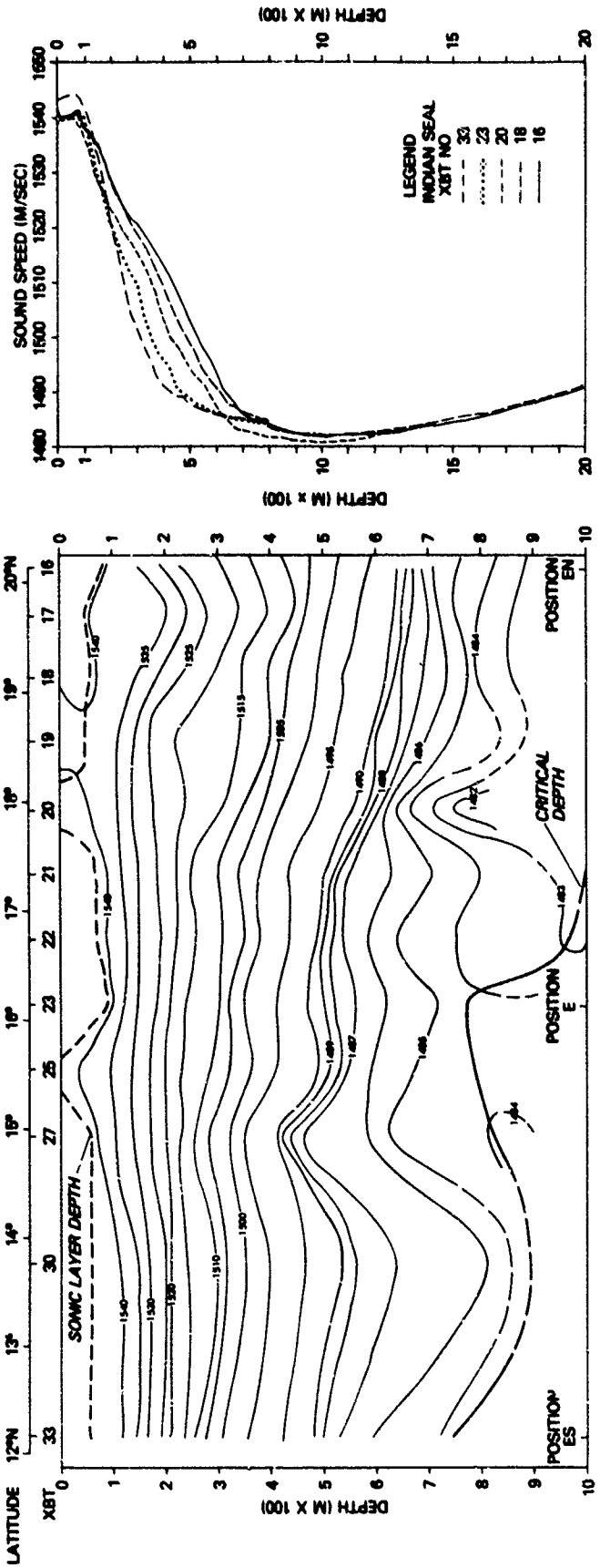


Figure 7 (C) Contoured section and composite of sound speed variability along the exercise baseline prior to Typhoon Lucy (U)

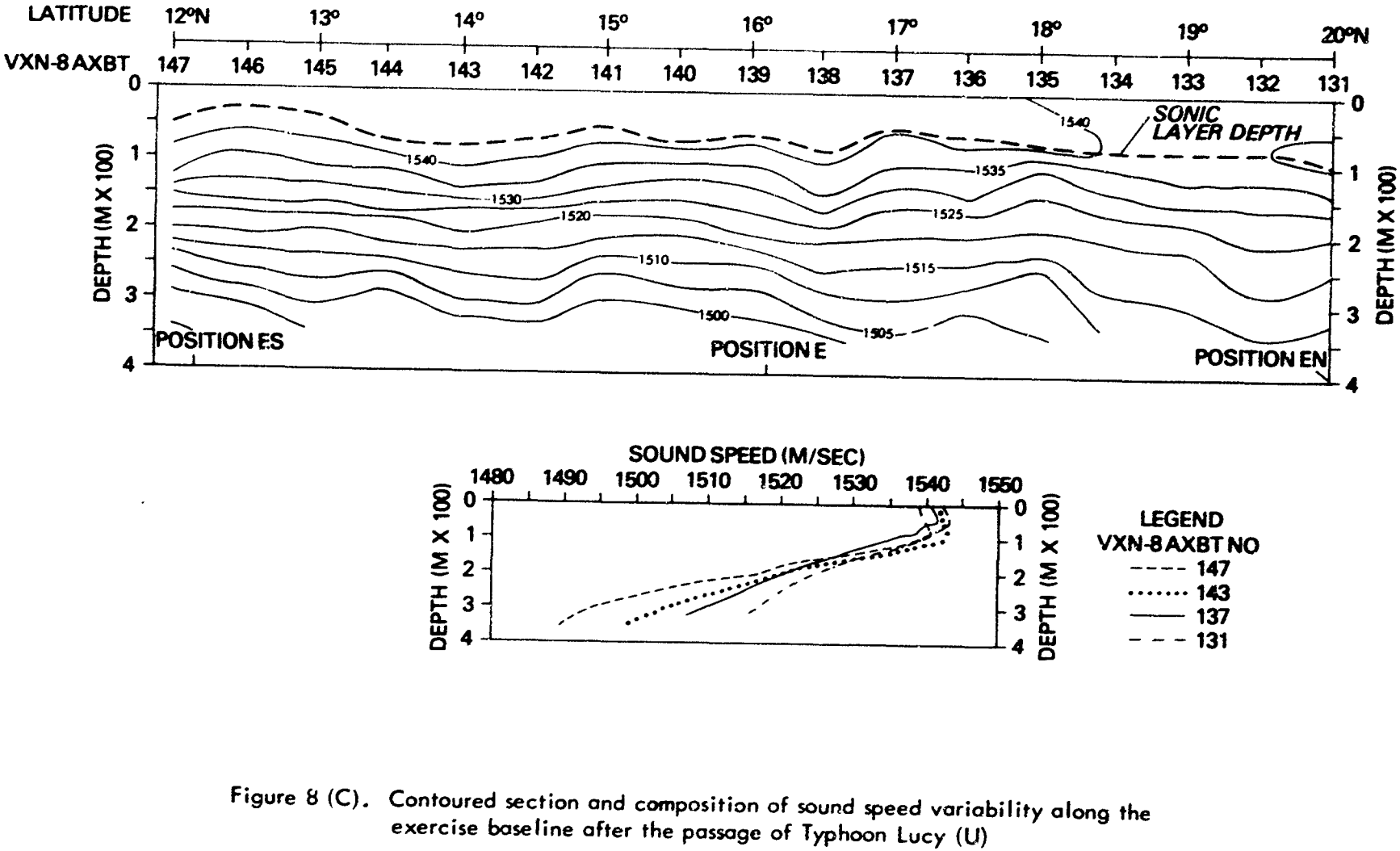


Figure 8 (C). Contoured section and composition of sound speed variability along the exercise baseline after the passage of Typhoon Lucy (U)

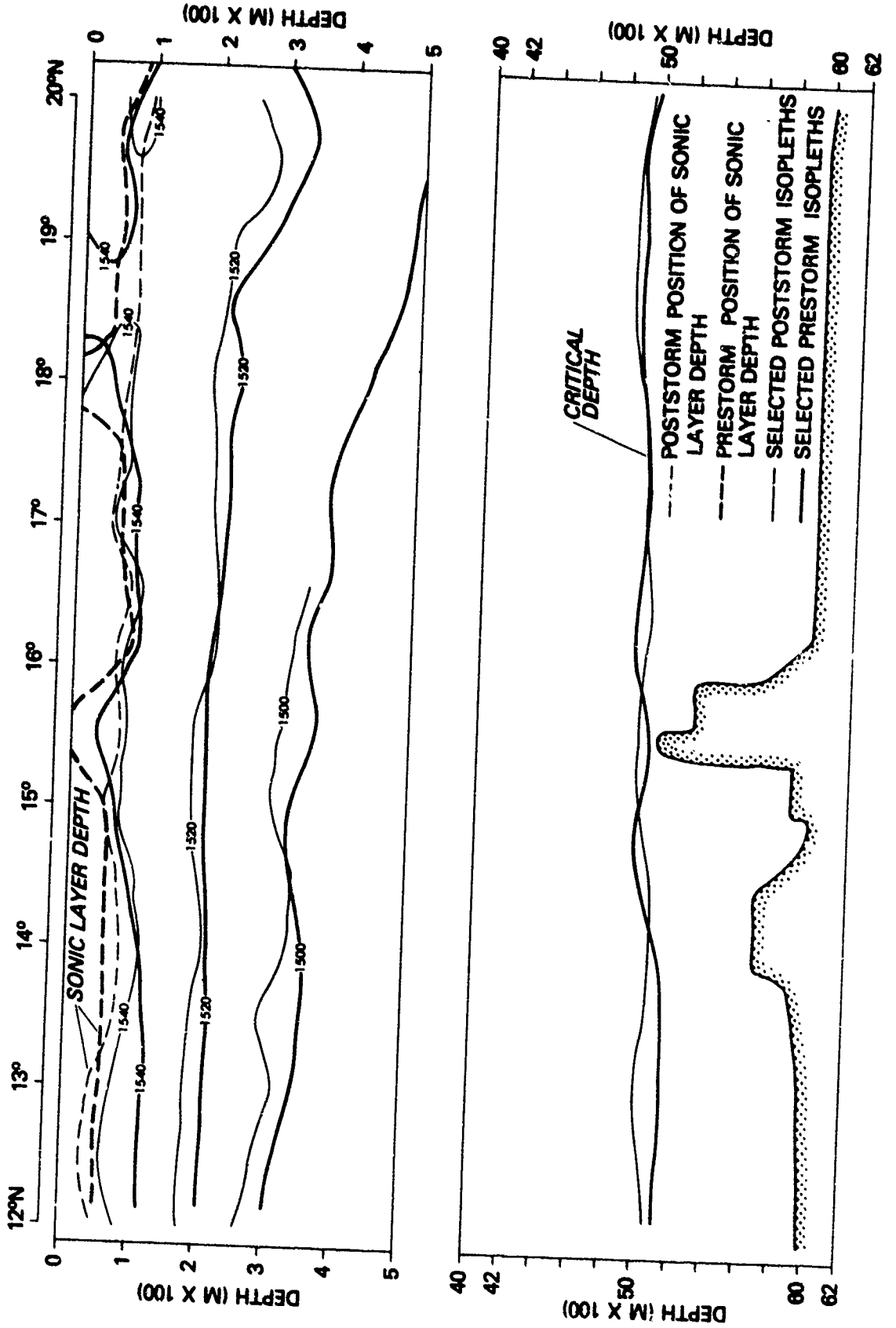


Figure 9 (C). Comparison of selected sound speed contours and parameters before and after the passage of Typhoon Lucy (U)

reflection of the sound speed at the sonic layer depth) as a result of the typhoon are almost nonexistent. From Site E to the north of Site EN, there is a large region where the critical depth is shoaler than the bottom topography (i.e., regions of depth excess). In this area, depth excess is adequate for convergence zone propagation from a near- surface source. In the immediate vicinity of Site E, however, the Central Basin Ridge very nearly coincides with the bottom of the sound channel.

(U) The large spatial variability not related to the typhoon is evident on both baseline sections. Sound speed values at 400 m depth on the composite of Figure 7 differ by 21.8 m/sec between Sites ES and EN. Variation at this depth is also evident by the deepening of the sound speed isolines from Site ES to Site EN. Nitani (1970) documents the existence of a cold eddy associated with upwelling of deep water in the vicinity of 7°N. It is likely that the relatively cool water found along the southern portion of the baseline is a result of this upwelled water. This phenomena results in a pronounced thermocline, hence, a stronger negative sound speed gradient below the surface mixed layer.

(U) The depth of the deep sound channel axis is also affected by the upwelling center to the south of Site ES. The sound channel axial depth, which averages 783 m from Site ES to 16°15'N along the baseline, increases to an average value of 1019 m between 16°45'N and Site EN. This deepening of the axial depth to the north is a result of weaker sound speed gradients (caused by warmer temperatures) above the sound channel.

VI. (U) SOUND SPEED VARIABILITY AT EXERCISE ACOUSTIC SITES

(U) Typical sound speed profiles at Site ES both before and after the typhoon are illustrated on Figure 10. These profiles were chosen from seven pre-storm measurements and two post-storm measurements taken by M/V INDIAN SEAL and VXN-8 aircraft within 11 nm of Site ES. The slightly lower sound speed in the upper water column, present in the post-storm profile, can be a result of either of the typhoon or of oceanographic variability independent of meteorological conditions.

(U) Figures 11 and 12 show sound speed composites and typical profiles collected at Site E before and after the typhoon, respectively. Each composite was compiled from an analysis of 18 observations taken during the LAMBDA operational periods. Since the pre-storm composite contains data taken within a 30 nm radius and the post-storm composite was taken within a 42 nm radius (both over a five- day period), temporal as well as spatial change is probably responsible for the observed variability. Nevertheless, the variability observed at Site E over the duration of the exercise is acoustically negligible.

(U) The typical sound speed profiles, as shown in Figure 13, resulted from five exercise measurements available within 17 nm of Site EN prior to and after the storm. The deeper mixed layer and lower sound speed values in the mixed layer can be attributed to the effects of Typhoon Lucy, since the relaxation time was only three days after its passage.

VII. (U) SOUND SPEED VARIABILITY ALONG THE USS BEAUFORT TRACK

(U) The CW projector tow made by USS BEAUFORT between Sites HX-47 and HX-75 extended over areas of both depth excess and bottom limited regions of the

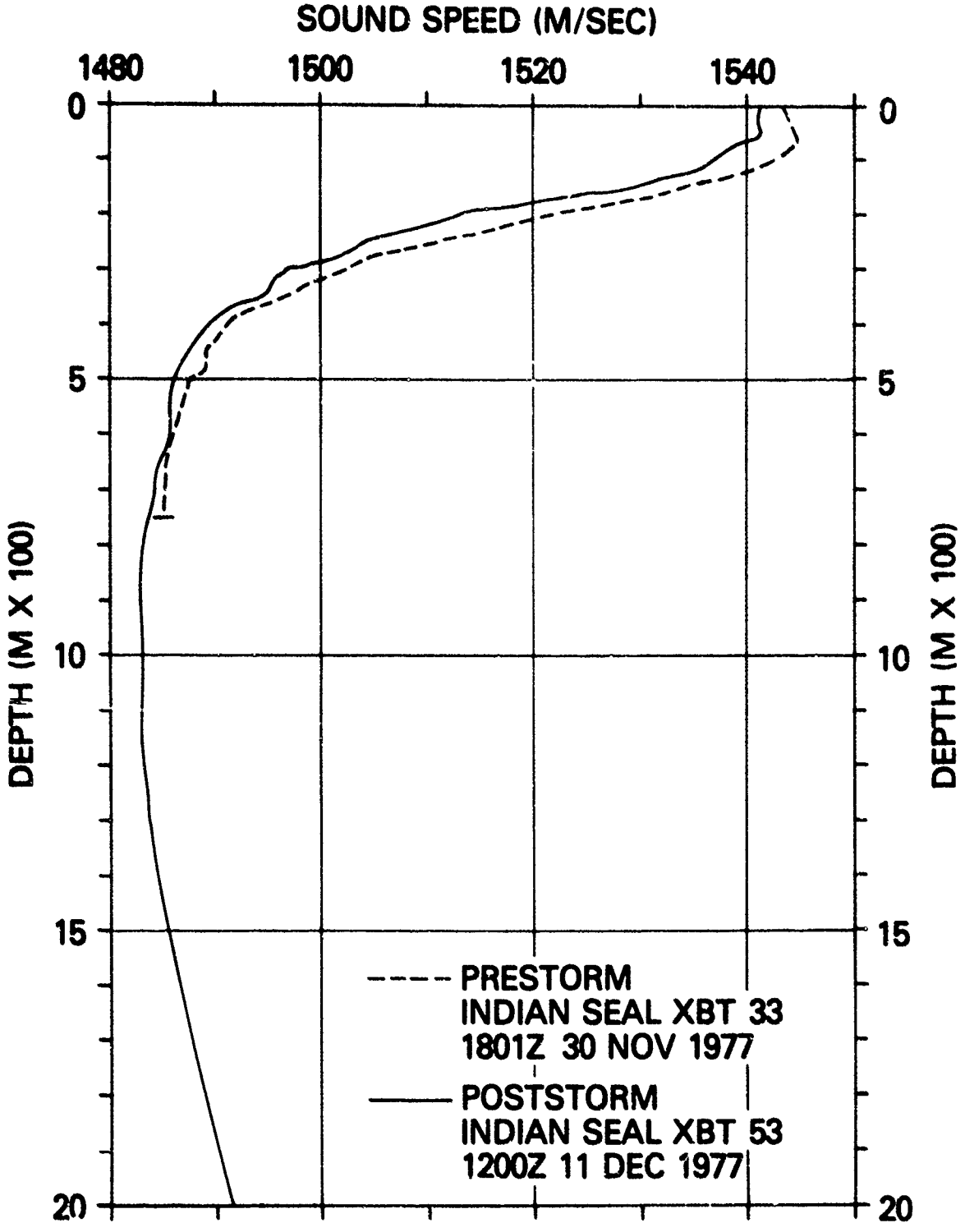


Figure 10 (C). Pre-storm and post-storm composite of sound speed variability of Site ES (U)

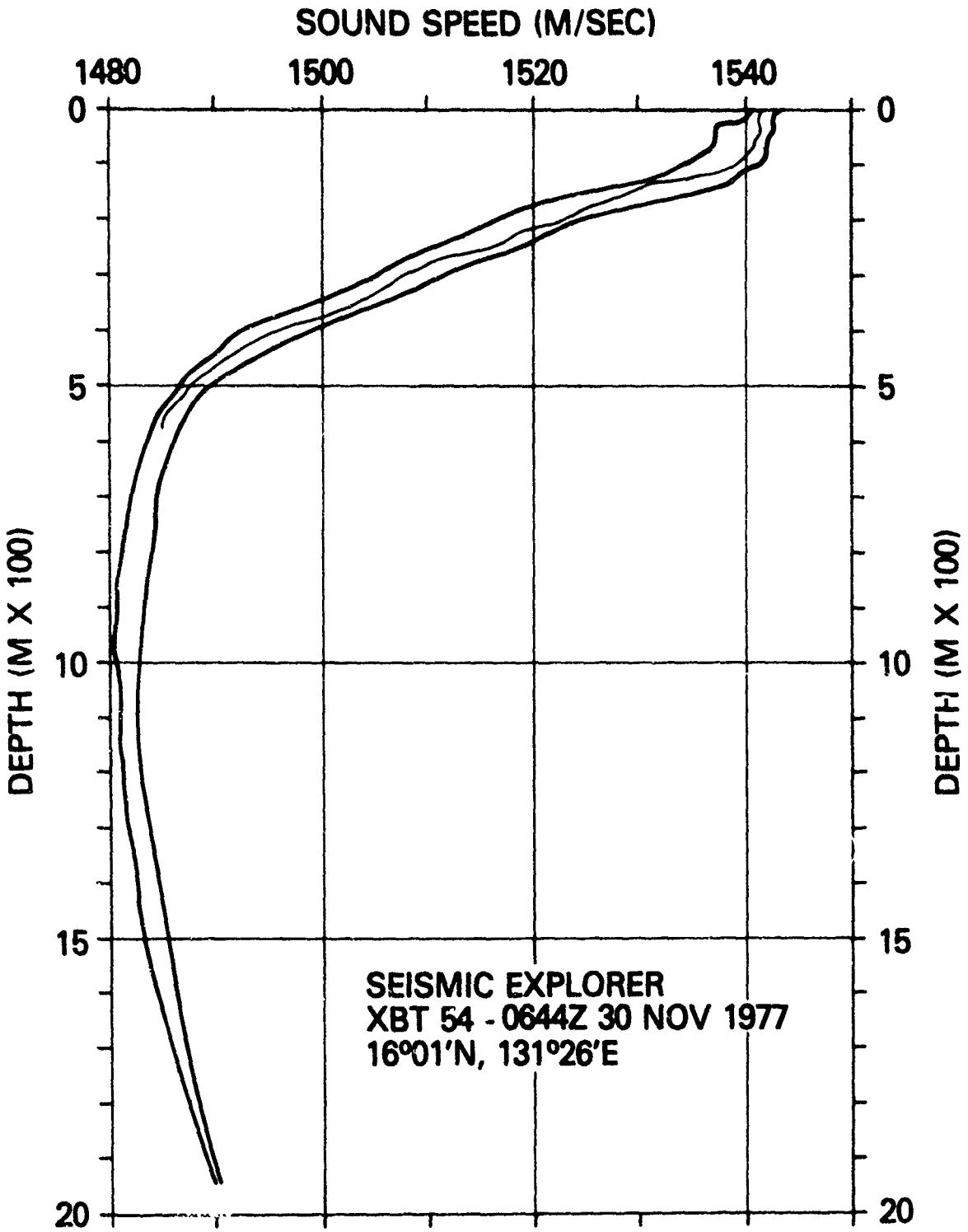


Figure 11 (C). Sound speed composite and typical profile during pre-storm LAMBDA deployment at Site E (U)

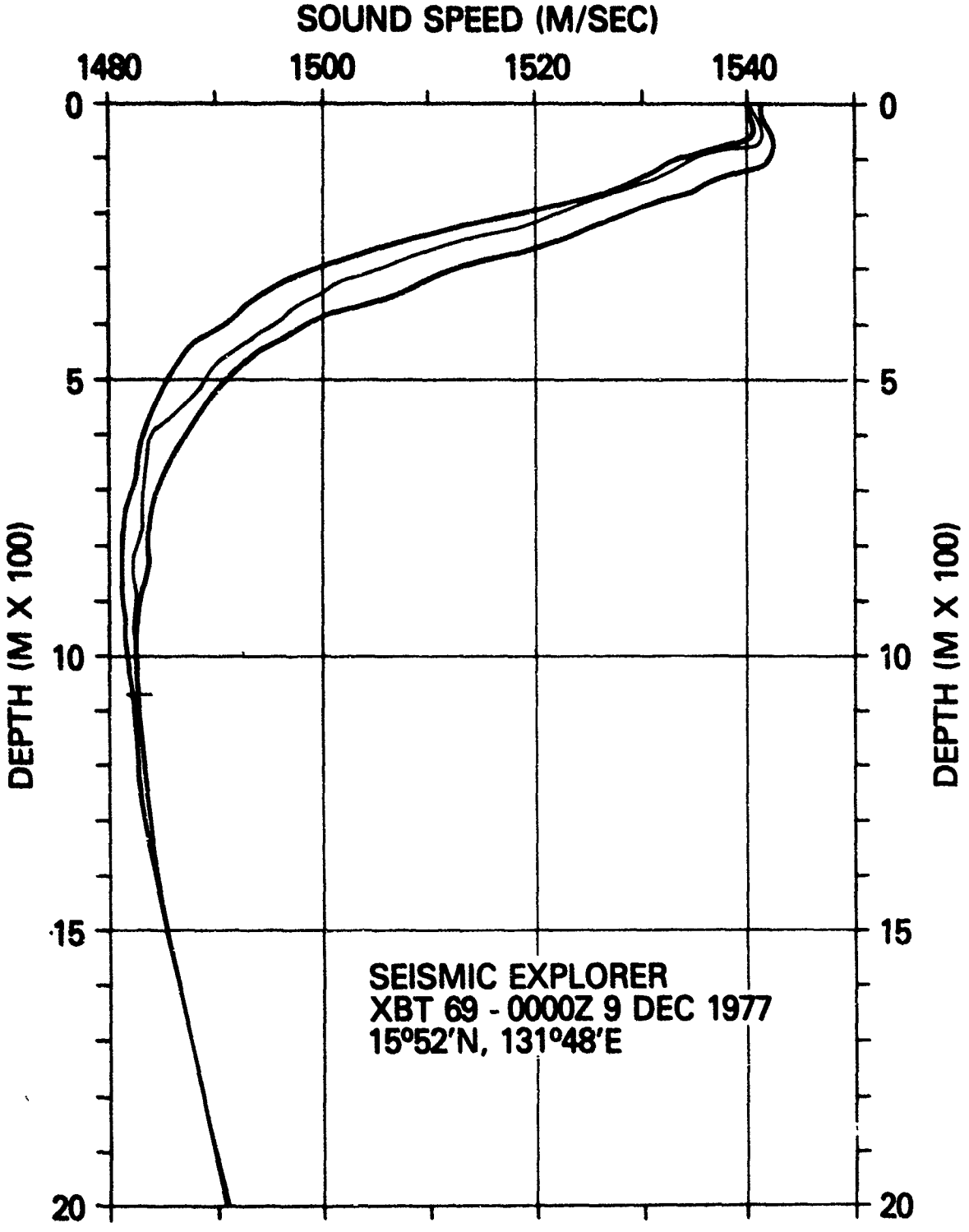


Figure 12 (C). Sound speed composite and typical profile during post-storm LAMBDA deployment at Site E (U)

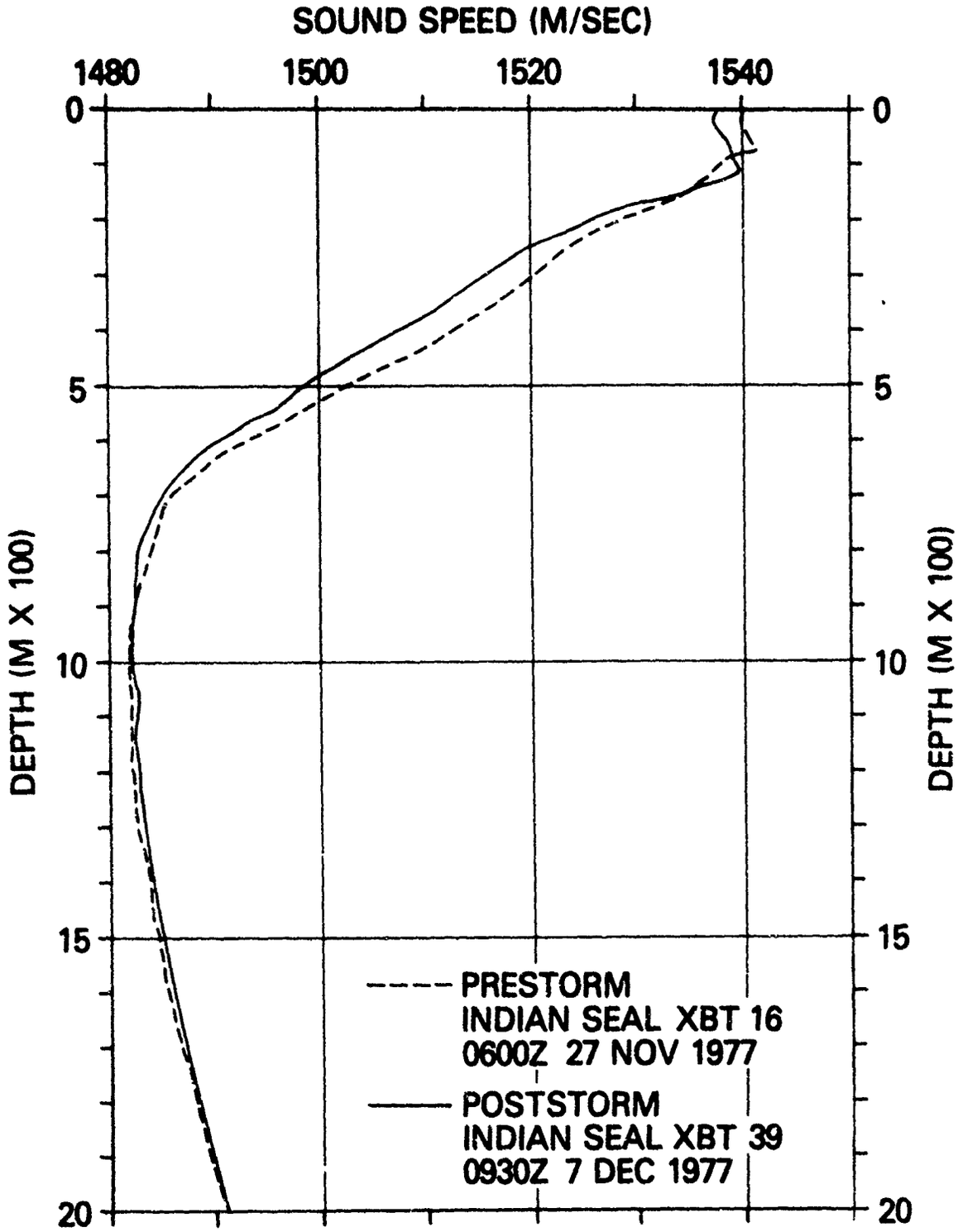


Figure 13 (C). Pre-storm and post-storm composite of sound speed variability at Site EN (U)

continental shelf. Figure 14 presents a sound speed section and Figure 15 illustrates a composite of five selected sound speed profiles along this track. The lack of near-surface sound speed variation and the persistent character of the sonic layer along the entire track are worthy of note. The retarded negative sound speed gradient between 200 and 400 m depth in the vicinity of Site HX-47 is caused by the existence of Subtropical Mode Water. This water mass, found to the north of the Subtropical Convergence, causes a pronounced bichannel sound speed structure north of the exercise area. The deep sound channel axis, discontinuous over the continental shelf, demonstrated little variation and remained generally deeper than 1000 m along the entire track. Critical depth also remained stable along the transit and exhibited little variation from its approximate 4600 m depth. The Ryukyu Trench offers depth excess as large as 2200 m, while the continental shelf associated with the Ryukyu Island arc and the Undaneta Ridge are bottom-limited.

(U) A VXN-8 AXBT and ART survey was taken over this area one and one-half days prior to the beginning of the USS BEAUFORT projector tow. A composite of all data from that survey revealed no evidence of surface or subsurface eddies which may have been generated by the Kuroshio Current and thus affected the environment east of the Ryukyu Island arc.

VIII. (U) CONCLUSIONS

(C) The intrusion of Typhoon Lucy through the exercise area during 1-7 December interrupted the timing of the exercise events more seriously than it affected the environment. Sound speed sections taken along the exercise baseline (12°-20°N along 132°E) prior to and following the typhoon indicate that the northern portion of the baseline (north of 17°30'N) was more adversely affected than the southern portions. This observation, however, is not surprising, since the time between the storm's passage and that of the measurements was only two and one-half days at the northern end, while six days had elapsed since the storm had traversed the southern extremes of the baseline. The depth of the sonic layer, already deep from four tropical cyclones in as many months, increased only an average of 13 m north of 17°30'N and remained essentially unchanged south of this latitude along the baseline. Sound speed values below the mixed layer and critical depth changed very little as a result of the storm's passage. Consequently, the effect of the typhoon on sound propagation should have been minimal.

(U) Environmental variability as measured at acoustic Sites ES, E, and EN over the duration of the exercise was found to be acoustically negligible. Spatial variability along the baseline (that variability not related to the typhoon) was significant. The sound speed value at 400 m at Site ES, for instance, was 21.8 m/sec lower than at Site EN. This comparatively large variation in sound speed was largely confined to the thermocline area of the water column and was caused by a center of upwelling centered at 7°N below the southern limit of the baseline. The existence of this permanent feature is also reflected in a shoaling of the sound channel axis from an average of 783 m south of 16°15'N to 1019 m north of 16°45'N along the baseline.

(U) The most pronounced change in the sound speed structure along the track of the USS BEAUFORT lies in the transition from the isovelocity structure found below the mixed layer in the vicinity of HX-47 to the typical negative gradient found along the remainder of the transit track. The sonic layer depth deep sound channel axial depth and critical depth were very stable along the entire CW tow track.

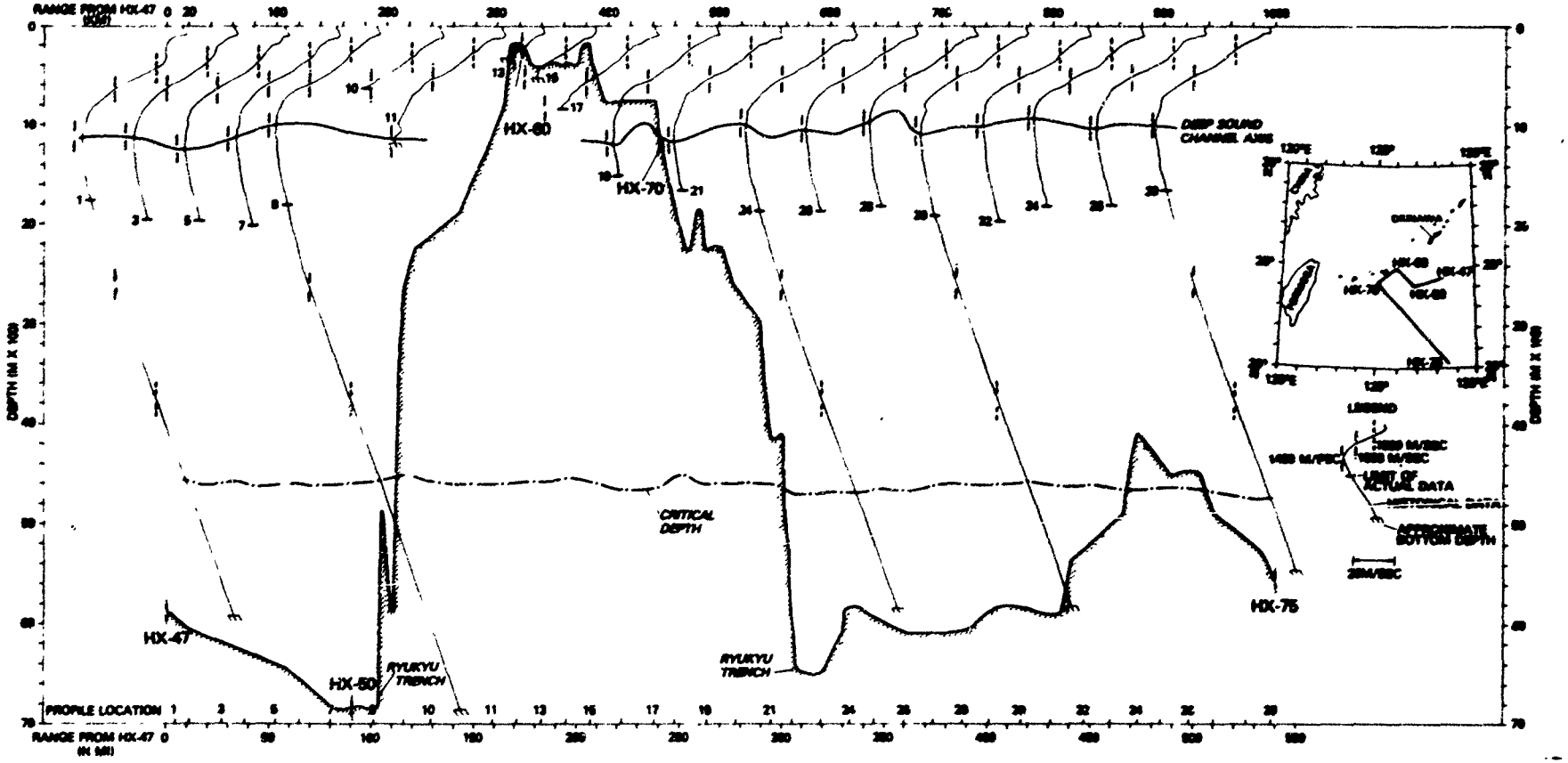


Figure 14 (C). Sound speed variability along USS BEAUFORT projector tow track, HX47 — HX75 (U)

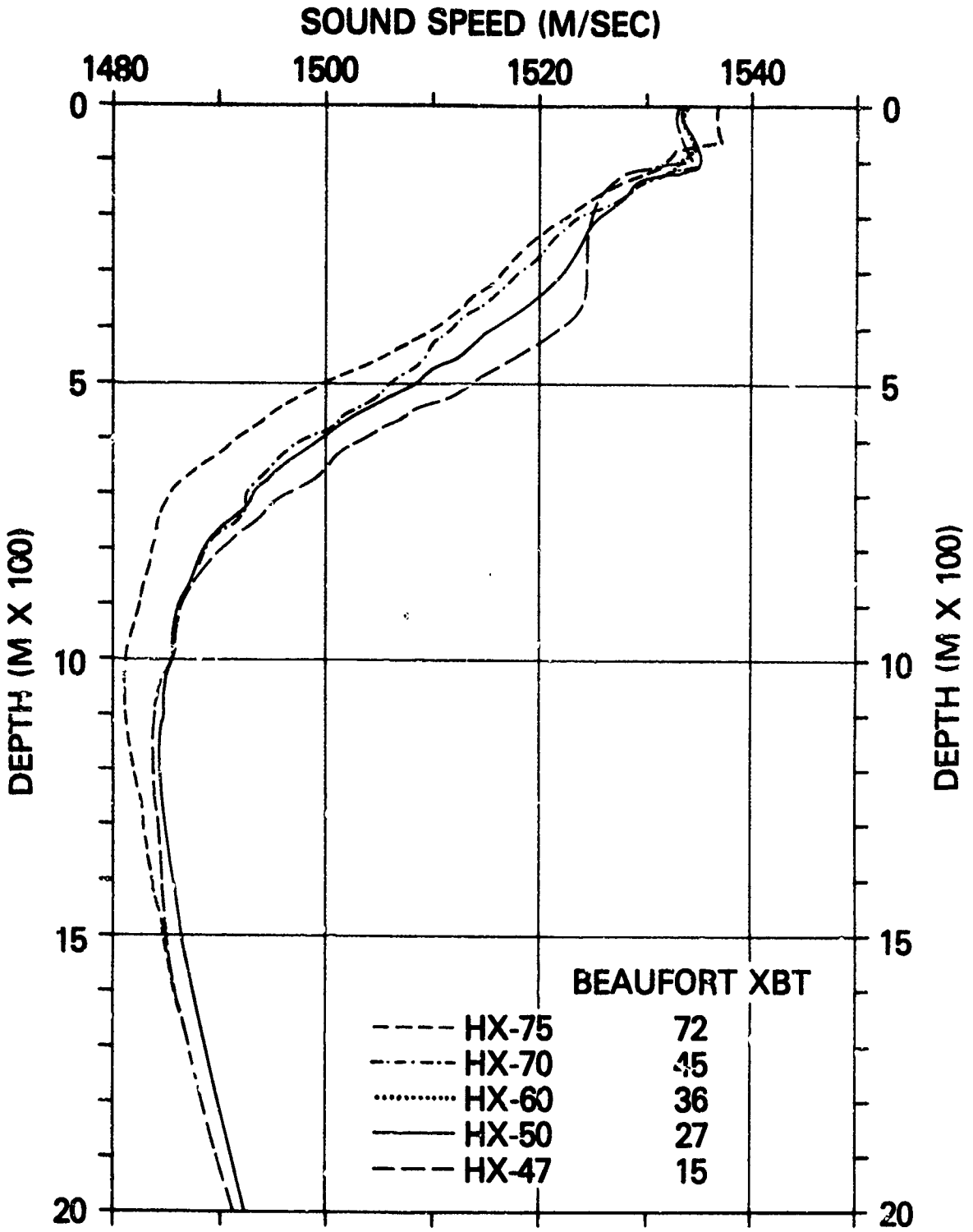


Figure 15 (C). Composite of selected sound speed profiles along the USS BEAUFORT tow track, HX47 — HX75 (U)

IX. (U) REFERENCES

Long Range Acoustic Propagation Project (1977). Exercise Plan for CHURCH STROKE Two Cruise 5 (U). Naval Ocean Research and Development Activity, NSTL Station, MS, LRAPP Rep. S77-010, SECRET.

Nitani, H. (1970). Oceanographic Conditions in the Sea East of the Philippines and Luzon Strait in Summers of 1965 and 1966. The Kurosho: A Symposium on the Japan Current, J. C. Marr (ed.), East West Center Press, Honolulu, HI, p. 213-232.

Nitani, H. (1972). Beginning of the Kuroshio. Kuroshio: Physical Aspects of the Japan Current, H. C. Stommel and K. Yoshida (ed.), University of Tokyo Press, Tokyo, Japan, p. 129-156.

Uda, M. (1955). On the Subtropical Convergence and the Currents in the Northwest Pacific. Rec. of Ocean. Works in Japan, v. 2, n. 1, p. 141-150.

Uda, M. (1969). The Eastward Subtropical Countercurrent in the Western North Pacific Ocean. J. Ocean. Soc. Japan, v. 25, n. 4, p. 201-210.

Wilson, W.D. (1960). Equation for the Speed of Sound in Sea Water. J. Acoust. Soc. Am., v. 32, n. 19, p. 1357.

APPENDIX A (U)

RECTIFIED NAVIGATION OF EXERCISE SURFACE PLATFORMS (U)

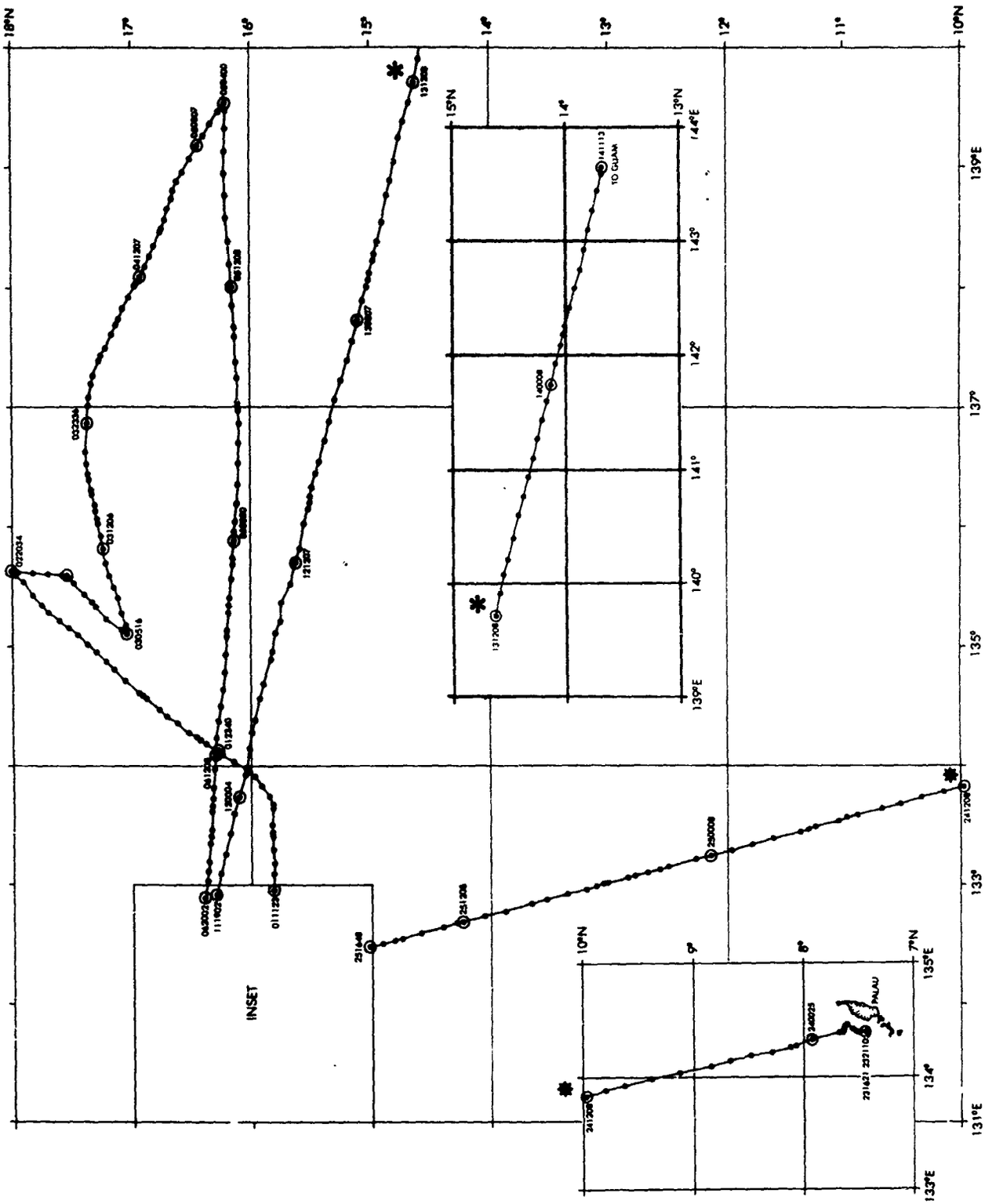
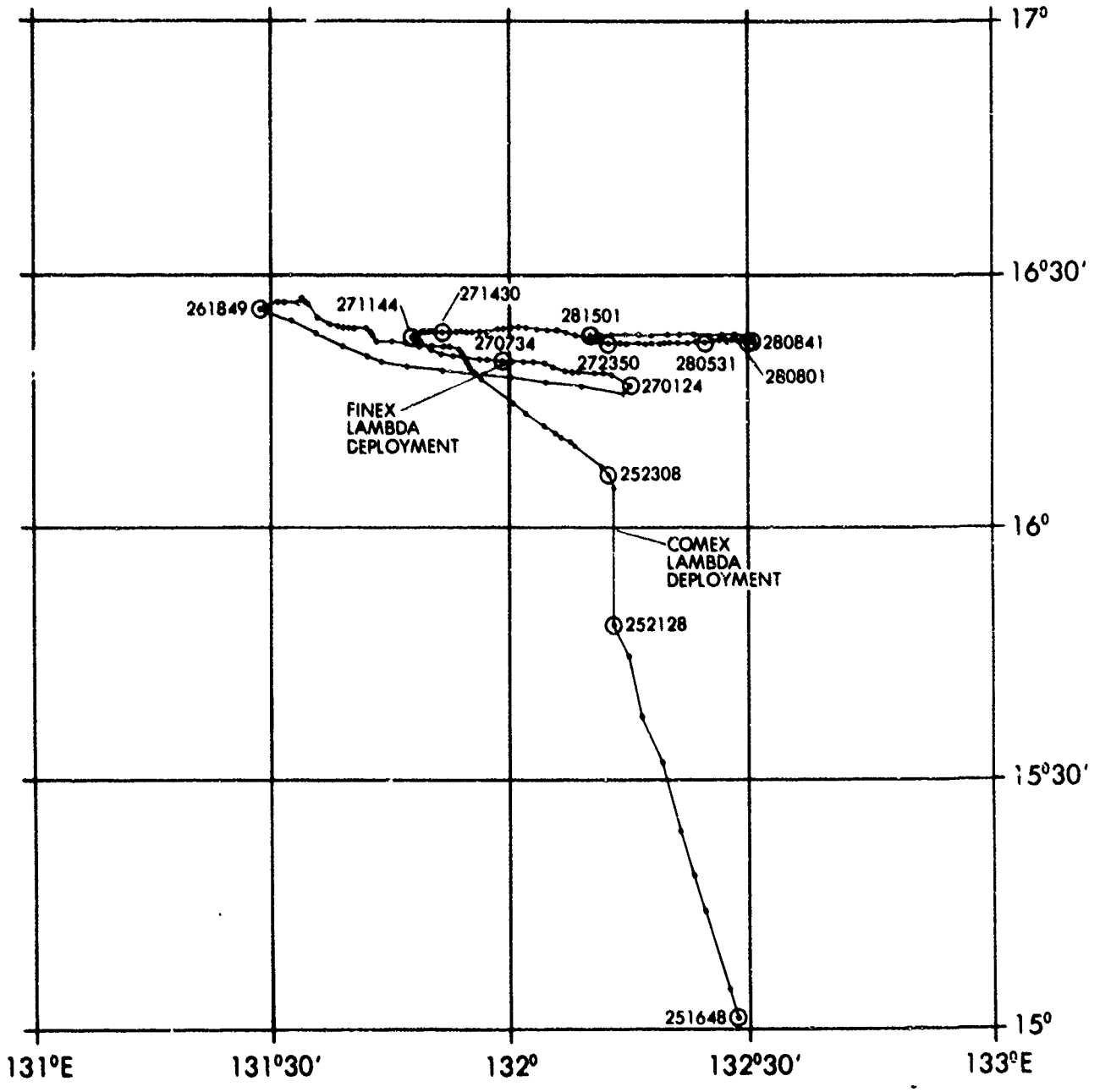
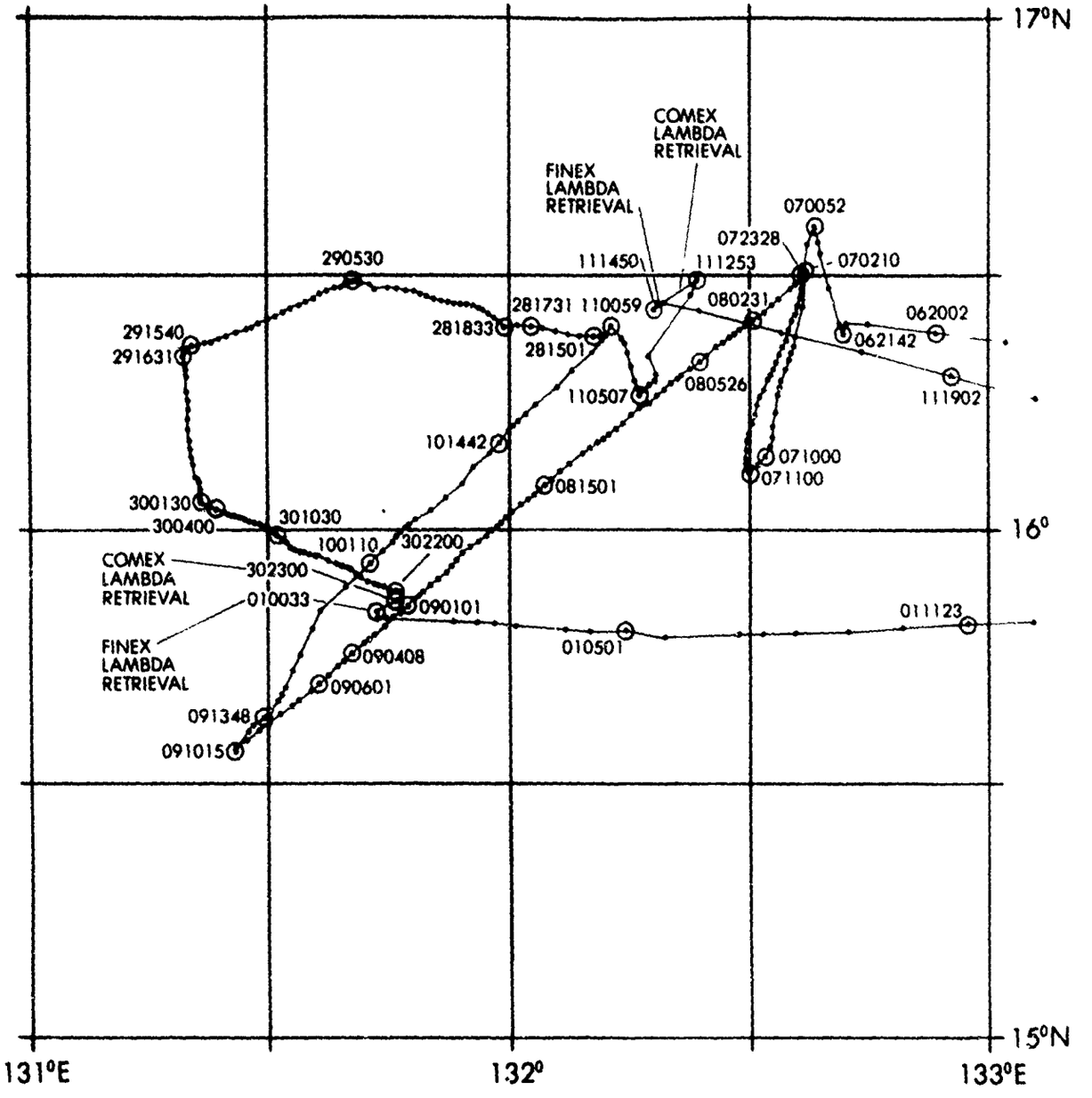


Figure 16 (C). Plot of M/V SEISMIC EXPLORER Phase 1 rectified navigation (U)



Inset to Figure 16 (U)



Inset to Figure 16 (U)

TABLE 1 (C)

TABULATION OF RECTIFIED NAVIGATION POSITIONS FOR M/V SEISMIC EXPLORER (U)

EVENT	LATITUDE	LONGITUDE	TIME (ZULU)	DATE
	7 260N	134 237E	1621	231177
20000 →	7 260N	134 237E	2110	231177
	7 296N	134 238E	2140	231177
	7 317N	134 241E	2149	231177
	7 331N	134 254E	2201	231177
	7 364N	134 277E	2223	231177
	7 376N	134 273E	2231	231177
	7 381N	134 255E	2241	231177
	7 384N	134 241E	2249	231177
	7 405N	134 234E	2301	231177
	7 556N	134 196E	0025	241177
	8 044N	134 165E	0144	241177
	8 074N	134 156E	0201	241177
	8 174N	134 130E	0256	241177
	8 291N	134 111E	0400	241177
	8 400N	134 087E	0500	241177
	8 509N	134 059E	0600	241177
	9 076N	134 020E	0727	241177
	9 230N	133 586E	0848	241177
	9 373N	133 550E	1008	241177
	9 477N	133 523E	1108	241177
	9 582N	133 494E	1208	241177
	10 089N	133 466E	1308	241177
	10 204N	133 439E	1408	241177
	10 311N	133 406E	1508	241177
	10 413N	133 380E	1602	241177
	10 538N	133 348E	1708	241177
	10 588N	133 337E	1736	241177
	11 034N	133 324E	1802	241177
	11 151N	133 292E	1908	241177
	11 184N	133 281E	1926	241177
	11 224N	133 270E	1948	241177
	11 370N	133 234E	2108	241177
	11 476N	133 205E	2208	241177
	11 580N	133 177E	2308	241177
	12 088N	133 148E	0008	251177
	12 162N	133 130E	0048	251177
	12 301N	133 090E	0208	251177
	12 347N	133 077E	0234	251177
	12 408N	133 062E	0308	251177
	12 471N	133 047E	0346	251177
	12 510N	133 037E	0408	251177
	13 011N	133 009E	0508	251177
	13 032N	133 004E	0520	251177
	13 069N	132 593E	0542	251177
	13 115N	132 579E	0608	251177
	13 216N	132 555E	0708	251177
	13 318N	132 527E	0808	251177
	13 397N	132 507E	0854	251177
	13 525N	132 470E	1008	251177
	14 032N	132 441E	1108	251177
	14 137N	132 413E	1208	251177
	14 170N	132 406E	1228	251177
	14 242N	132 386E	1308	251177
	14 354N	132 354E	1414	251177
	14 446N	132 329E	1508	251177
	14 482N	132 321E	1536	251177
	14 546N	132 304E	1608	251177
	15 011N	132 288E	1648	251177
	15 047N	132 277E	1710	251177
	15 142N	132 246E	1808	251177
	15 184N	132 232E	1834	251177
	15 239N	132 216E	1908	251177
	15 321N	132 194E	1958	251177
	15 375N	132 167E	2028	251177
	15 447N	132 144E	2108	251177
	15 483N	132 132E	2128	251177
20300 →	16 048N	132 132E	2258	251177
	16 064N	132 129E	2308	251177
	16 073N	132 117E	2328	251177
	16 098N	132 081E	0008	261177
	16 101N	132 076E	0028	261177
	16 108N	132 065E	0058	261177
	16 114N	132 059E	0138	261177
	16 122N	132 044E	0158	261177
	16 137N	132 021E	0218	261177
	16 149N	132 006E	0306	261177
	16 176N	131 569E	0408	261177
	16 185N	131 557E	0428	261177
	16 189N	131 555E	0456	261177
	16 198N	131 548E	0538	261177
	16 202N	131 545E	0558	261177
	16 204N	131 545E	0608	261177
	16 205N	131 545E	0620	261177
	16 214N	131 538E	0658	261177
	16 216N	131 526E	0728	261177
	16 215N	131 520E	0746	261177
	16 217N	131 505E	0808	261177
	16 219N	131 489E	0838	261177
	16 220N	131 472E	0908	261177
	16 221N	131 454E	0938	261177
	16 223N	131 431E	1018	261177
	16 228N	131 429E	1108	261177
	16 232N	131 428E	1148	261177
	16 236N	131 421E	1208	261177
	16 237N	131 405E	1238	261177
	16 237N	131 400E	1248	261177
	16 239N	131 391E	1308	261177
	16 240N	131 387E	1320	261177
	16 242N	131 373E	1358	261177
	16 251N	131 360E	1436	261177
	16 267N	131 347E	1538	261177
	16 269N	131 342E	1548	261177
	16 270N	131 341E	1604	261177
	16 270N	131 339E	1624	261177
	16 268N	131 337E	1649	261177

EVENT	LATITUDE	LONGITUDE	TIME (ZULU)	DATE
	16 269N	131 315E	1729	261177
	16 269N	131 309E	1744	261177
	16 261N	131 294E	1809	261177
	16 259N	131 291E	1849	261177
	16 245N	131 326E	1922	261177
	16 230N	131 359E	1954	261177
	16 217N	131 391E	2024	261177
	16 204N	131 422E	2054	261177
	16 197N	131 439E	2110	261177
	16 193N	131 474E	2134	261177
	16 187N	131 517E	2204	261177
	16 182N	131 561E	2234	261177
	16 177N	132 005E	2304	261177
	16 171N	132 048E	2334	261177
	16 166N	132 092E	0004	271177
	16 159N	132 147E	0042	271177
	16 169N	132 153E	0124	271177
	16 181N	132 129E	0204	271177
	16 183N	132 121E	0224	271177
	16 183N	132 109E	0254	271177
	16 184N	132 087E	0324	271177
	16 186N	132 081E	0348	271177
	16 189N	132 074E	0424	271177
	16 191N	132 056E	0504	271177
	16 195N	132 048E	0530	271177
	16 195N	132 033E	0604	271177
	16 197N	132 018E	0640	271177
	16 198N	132 005E	0704	271177
21000 →	16 198N	131 590E	0734	271177
	16 199N	131 575E	0804	271177
	16 200N	131 567E	0824	271177
	16 202N	131 544E	0904	271177
	16 205N	131 529E	0934	271177
	16 208N	131 515E	1004	271177
	16 214N	131 502E	1034	271177
	16 220N	131 491E	1104	271177
	16 224N	131 484E	1124	271177
	16 226N	131 478E	1144	271177
	16 225N	131 480E	1204	271177
	16 227N	131 482E	1214	271177
	16 230N	131 486E	1226	271177
	16 231N	131 488E	1244	271177
	16 232N	131 491E	1302	271177
	16 233N	131 502E	1348	271177
	16 232N	131 511E	1410	271177
	16 233N	131 518E	1430	271177
	16 233N	131 527E	1500	271177
	16 233N	131 537E	1530	271177
	16 233N	131 539E	1536	271177
	16 233N	131 548E	1600	271177
	16 233N	131 557E	1630	271177
	16 234N	131 566E	1656	271177
	16 234N	131 574E	1720	271177

EVENT	LATITUDE	LONGITUDE	TIME (ZULU)	DATE
	16 236N	131 590E	1801	271177
	16 236N	131 595E	1816	271177
	16 237N	132 005E	1842	271177
	16 237N	132 013E	1901	271177
	16 237N	132 024E	1931	271177
	16 235N	132 036E	2000	271177
	16 234N	132 049E	2031	271177
	16 234N	132 061E	2101	271177
	16 232N	132 077E	2131	271177
	16 229N	132 085E	2201	271177
	16 225N	132 096E	2231	271177
	16 222N	132 108E	2301	271177
	16 220N	132 119E	2331	271177
	16 218N	132 126E	2350	271177
	16 216N	132 140E	0031	281177
	16 217N	132 150E	0101	281177
	16 218N	132 163E	0134	281177
	16 219N	132 172E	0201	281177
	16 219N	132 183E	0231	281177
	16 218N	132 193E	0300	281177
	16 219N	132 199E	0318	281177
	16 219N	132 205E	0333	281177
	16 219N	132 215E	0401	281177
	16 220N	132 225E	0431	281177
	16 221N	132 237E	0504	281177
	16 222N	132 247E	0531	281177
	16 223N	132 257E	0601	281177
	16 223N	132 267E	0628	281177
	16 225N	132 279E	0701	281177
	16 225N	132 286E	0718	281177
	16 224N	132 292E	0733	281177
22040 →	16 224N	132 302E	0801	281177
	16 223N	132 307E	0825	281177
	16 223N	132 309E	0841	281177
	16 227N	132 304E	0901	281177
	16 228N	132 296E	0931	281177
	16 228N	132 268E	1001	281177
	16 228N	132 251E	1031	281177
	16 229N	132 233E	1101	281177
	16 229N	132 216E	1131	281177
	16 229N	132 199E	1201	281177
	16 229N	132 181E	1231	281177
	16 230N	132 164E	1301	281177
	16 230N	132 147E	1331	281177
	16 229N	132 131E	1401	281177
	16 227N	132 115E	1431	281177
	16 227N	132 110E	1444	281177
	16 227N	132 099E	1501	281177
	16 228N	132 084E	1531	281177
	16 229N	132 068E	1601	281177
	16 233N	132 055E	1630	281177
	16 236N	132 038E	1701	281177
	16 238N	132 022E	1731	281177

EVENT	LATITUDE	LONGITUDE	TIME (ZULU)	DATE
	16 239N	132 007E	1801	281177
21600	16 239N	131 590E	1833	281177
	16 242N	131 586E	1852	281177
	16 249N	131 578E	1931	281177
	16 253N	131 572E	2000	281177
	16 259N	131 564E	2040	281177
	16 260N	131 559E	2100	281177
	16 262N	131 551E	2130	281177
	16 263N	131 543E	2200	281177
	16 265N	131 535E	2230	281177
	16 266N	131 527E	2300	281177
	16 268N	131 519E	2330	281177
	16 269N	131 510E	0000	291177
	16 271N	131 501E	0038	291177
	16 274N	131 492E	0106	291177
	16 277N	131 486E	0130	291177
	16 278N	131 476E	0200	291177
	16 278N	131 468E	0224	291177
	16 282N	131 456E	0300	291177
	16 283N	131 445E	0330	291177
	16 282N	131 430E	0414	291177
	16 286N	131 423E	0430	291177
	16 288N	131 412E	0500	291177
22100	16 289N	131 401E	0530	291177
	16 288N	131 396E	0544	291177
	16 287N	131 390E	0600	291177
	16 283N	131 386E	0612	291177
	16 281N	131 379E	0631	291177
	16 278N	131 368E	0701	291177
	16 274N	131 359E	0731	291177
	16 270N	131 352E	0756	291177
	16 265N	131 342E	0831	291177
	16 261N	131 333E	0901	291177
	16 257N	131 323E	0931	291177
	16 253N	131 314E	1001	291177
	16 249N	131 305E	1031	291177
	16 246N	131 296E	1101	291177
	16 242N	131 286E	1131	291177
	16 237N	131 276E	1201	291177
	16 234N	131 269E	1222	291177
	16 230N	131 255E	1301	291177
	16 227N	131 245E	1331	291177
	16 223N	131 234E	1406	291177
	16 221N	131 225E	1431	291177
	16 218N	131 215E	1501	291177
	16 217N	131 209E	1518	291177
22300	16 215N	131 202E	1540	291177
	16 212N	131 195E	1601	291177
	16 208N	131 191E	1615	291177
	16 203N	131 189E	1631	291177
	16 192N	131 191E	1710	291177
	16 186N	131 192E	1728	291177
	16 177N	131 193E	1750	291177

EVENT	LATITUDE	LONGITUDE	TIME (ZULU)	DATE
	16 162N	131 194E	1831	291177
	16 154N	131 196E	1852	291177
	16 140N	131 196E	1930	291177
	16 127N	131 196E	2001	291177
	16 116N	131 197E	2031	291177
	16 104N	131 198E	2101	291177
	16 093N	131 199E	2133	291177
	16 084N	131 201E	2201	291177
	16 076N	131 202E	2221	291177
	16 060N	131 205E	2317	291177
	16 057N	131 208E	2337	291177
	16 055N	131 209E	2346	291177
	16 046N	131 210E	0015	301177
	16 038N	131 211E	0045	301177
	16 033N	131 211E	0101	301177
22400	16 030N	131 211E	0130	301177
	16 029N	131 217E	0230	301177
	16 027N	131 223E	0300	301177
	16 025N	131 227E	0324	301177
	16 022N	131 234E	0400	301177
	16 019N	131 242E	0448	301177
	16 018N	131 248E	0512	301177
	16 017N	131 251E	0530	301177
	16 015N	131 256E	0600	301177
	16 013N	131 263E	0636	301177
	16 012N	131 267E	0654	301177
	16 009N	131 274E	0730	301177
	16 008N	131 280E	0800	301177
	16 005N	131 288E	0836	301177
	16 004N	131 293E	0900	301177
	16 002N	131 299E	0930	301177
	15 597N	131 304E	1000	301177
	15 593N	131 308E	1030	301177
	15 588N	131 313E	1100	301177
	15 584N	131 320E	1130	301177
	15 577N	131 323E	1201	301177
	15 575N	131 330E	1231	301177
	15 573N	131 336E	1301	301177
	15 572N	131 343E	1331	301177
	15 569N	131 350E	1401	301177
	15 569N	131 357E	1431	301177
	15 567N	131 364E	1452	301177
	15 563N	131 372E	1531	301177
	15 559N	131 382E	1610	301177
	15 558N	131 388E	1640	301177
	15 556N	131 394E	1711	301177
	15 553N	131 398E	1740	301177
	15 550N	131 402E	1758	301177
	15 547N	131 406E	1824	301177
	15 543N	131 413E	1900	301177
	15 540N	131 420E	1930	301177
	15 536N	131 429E	2010	301177
	15 534N	131 434E	2030	301177

EVENT	LATITUDE	LONGITUDE	TIME (ZULU)	DATE
15	531N	131 441E	2100	301177
15	529N	131 449E	2130	301177
15	525N	131 456E	2200	301177
15	528N	131 460E	2224	301177
15	523N	131 461E	2244	301177
15	515N	131 456E	2300	301177
15	501N	131 434E	0037	011277
15	495N	131 433E	0044	011277
15	496N	131 454E	0101	011277
15	493N	131 528E	0201	011277
15	491N	131 556E	0222	011277
15	489N	131 580E	0242	011277
15	488N	132 003E	0301	011277
15	484N	132 065E	0354	011277
15	482N	132 097E	0422	011277
15	480N	132 144E	0501	011277
15	474N	132 192E	0542	011277
15	478N	132 283E	0701	011277
15	478N	132 315E	0728	011277
15	479N	132 354E	0801	011277
15	481N	132 423E	0901	011277
15	485N	132 494E	1001	011277
15	490N	132 572E	1123	011277
15	491N	133 055E	1216	011277
15	492N	133 111E	1303	011277
15	494N	133 182E	1404	011277
15	495N	133 251E	1503	011277
15	495N	133 269E	1520	011277
15	494N	133 304E	1550	011277
15	493N	133 390E	1706	011277
15	493N	133 409E	1723	011277
15	510N	133 449E	1803	011277
15	545N	133 500E	1902	011277
15	588N	133 550E	2003	011277
16	012N	133 571E	2033	011277
16	027N	133 581E	2052	011277
16	089N	134 022E	2203	011277
16	143N	134 056E	2303	011277
16	175N	134 079E	2340	011277
16	226N	134 110E	0034	021277
16	254N	134 128E	0104	021277
16	276N	134 142E	0126	021277
16	313N	134 167E	0204	021277
16	371N	134 208E	0306	021277
16	425N	134 250E	0404	021277
16	466N	134 285E	0450	021277
16	523N	134 339E	0604	021277
16	544N	134 351E	0622	021277
16	564N	134 368E	0648	021277
17	033N	134 427E	0808	021277
17	089N	134 483E	0914	021277
17	129N	134 522E	1004	021277
17	179N	134 569E	1104	021277

EVENT	LATITUDE	LONGITUDE	TIME (ZULU)	DATE
17	224N	135 011E	1204	021277
17	274N	135 058E	1310	021277
17	317N	135 094E	1404	021277
17	366N	135 130E	1502	021277
17	417N	135 168E	1604	021277
17	449N	135 202E	1649	021277
17	499N	135 257E	1758	021277
17	541N	135 308E	1904	021277
17	586N	135 351E	2004	021277
18	009N	135 375E	2034	021277
17	599N	135 376E	2044	021277
17	571N	135 375E	2104	021277
17	495N	135 368E	2204	021277
17	419N	135 361E	2304	021277
17	348N	135 354E	0004	031277
17	325N	135 353E	0024	031277
17	320N	135 352E	0030	031277
17	290N	135 317E	0104	031277
17	276N	135 256E	0204	031277
17	197N	135 216E	0246	031277
17	180N	135 197E	0304	031277
17	126N	135 139E	0400	031277
17	050N	135 080E	0459	031277
17	027N	135 064E	0516	031277
17	024N	135 076E	0529	031277
17	030N	135 107E	0559	031277
17	050N	135 166E	0658	031277
17	069N	135 222E	0756	031277
17	089N	135 296E	0906	031277
17	110N	135 356E	1006	031277
17	129N	135 420E	1106	031277
17	141N	135 490E	1206	031277
17	153N	135 556E	1306	031277
17	169N	136 016E	1400	031277
17	173N	136 031E	1420	031277
17	183N	136 080E	1522	031277
17	190N	136 110E	1600	031277
17	200N	136 167E	1710	031277
17	204N	136 183E	1730	031277
17	215N	136 238E	1834	031277
17	221N	136 266E	1906	031277
17	227N	136 319E	2006	031277
17	230N	136 374E	2106	031277
17	223N	136 512E	2336	031277
17	217N	137 007E	0120	041277
17	213N	137 050E	0202	041277
17	205N	137 115E	0308	041277
17	194N	137 158E	0348	041277
17	161N	137 233E	0454	041277
17	151N	137 258E	0516	041277
17	132N	137 298E	0554	041277
17	099N	137 369E	0700	041277
17	076N	137 411E	0738	041277

EVENT	LATITUDE	LONGITUDE	TIME (ZULU)	DATE
	17 062N	137 441E	0807	041277
	17 041N	137 499E	0907	041277
	17 012N	137 551E	1007	041277
	16 582N	138 005E	1107	041277
	16 576N	138 017E	1120	041277
	16 555N	138 058E	1207	041277
	16 532N	138 104E	1304	041277
	16 508N	138 156E	1407	041277
	16 482N	138 211E	1510	041277
	16 454N	138 279E	1618	041277
	16 447N	138 298E	1638	041277
	16 429N	138 343E	1728	041277
	16 414N	138 395E	1822	041277
	16 400N	138 442E	1912	041277
	16 389N	138 480E	2007	041277
	16 365N	138 527E	2107	041277
	16 340N	138 574E	2207	041277
	16 301N	139 043E	2307	041277
	16 265N	139 111E	0007	051277
	16 234N	139 162E	0107	051277
	16 199N	139 221E	0207	051277
	16 162N	139 289E	0258	051277
24000 ►	16 124N	139 327E	0400	051277
	16 125N	139 289E	0422	051277
	16 120N	139 199E	0504	051277
	16 126N	139 081E	0606	051277
	16 124N	138 570E	0704	051277
	16 120N	138 458E	0804	051277
	16 116N	138 345E	0904	051277
	16 109N	138 232E	1004	051277
	16 101N	138 118E	1104	051277
	16 095N	138 008E	1208	051277
	16 088N	137 508E	1300	051277
	16 080N	137 399E	1358	051277
	16 078N	137 354E	1422	051277
	16 070N	137 230E	1526	051277
	16 067N	137 146E	1610	051277
	16 061N	137 022E	1714	051277
	16 059N	136 583E	1734	051277
	16 056N	136 521E	1806	051277
	16 054N	136 417E	1900	051277
	16 054N	136 322E	1952	051277
	16 060N	136 210E	2100	051277
	16 069N	136 118E	2200	051277
	16 078N	136 025E	2300	051277
	16 080N	135 580E	2332	051277
	16 083N	135 534E	0000	061277
	16 089N	135 441E	0100	061277
	16 091N	135 416E	0118	061277
	16 096N	135 339E	0208	061277
	16 103N	135 244E	0310	061277
	16 109N	135 210E	0332	061277
	16 111N	135 174E	0356	061277

EVENT	LATITUDE	LONGITUDE	TIME (ZULU)	DATE
	16 116N	135 082E	0456	061277
	16 118N	135 050E	0516	061277
	16 123N	134 566E	0608	061277
	16 129N	134 470E	0710	061277
	16 140N	134 381E	0808	061277
	16 154N	134 301E	0908	061277
	16 165N	134 222E	1008	061277
	16 175N	134 138E	1108	061277
	16 181N	134 053E	1208	061277
	16 185N	133 580E	1300	061277
	16 190N	133 487E	1402	061277
	16 194N	133 437E	1436	061277
	16 196N	133 396E	1502	061277
	16 197N	133 370E	1520	061277
	16 201N	133 278E	1620	061277
	16 203N	133 243E	1642	061277
	16 205N	133 208E	1704	061277
	16 213N	133 114E	1802	061277
	16 217N	133 068E	1832	061277
	16 223N	133 020E	1902	061277
	16 234N	132 531E	2002	061277
	16 243N	132 444E	2102	061277
	16 245N	132 416E	2122	061277
	16 230N	132 414E	2142	061277
	16 243N	132 409E	2202	061277
	16 285N	132 397E	2302	061277
	16 325N	132 385E	0002	071277
	16 338N	132 384E	0022	071277
	16 357N	132 377E	0052	071277
	16 335N	132 369E	0132	071277
	16 302N	132 363E	0210	071277
	16 264N	132 365E	0304	071277
	16 227N	132 354E	0342	071277
	16 217N	132 350E	0404	071277
	16 210N	132 348E	0428	071277
	16 202N	132 346E	0454	071277
	16 188N	132 342E	0532	071277
	16 174N	132 337E	0616	071277
	16 168N	132 335E	0632	071277
	16 158N	132 332E	0702	071277
	16 140N	132 329E	0748	071277
	16 122N	132 326E	0832	071277
	16 110N	132 325E	0902	071277
	16 098N	132 324E	0932	071277
	16 089N	132 317E	1000	071277
	16 079N	132 308E	1030	071277
	16 069N	132 297E	1100	071277
	16 073N	132 293E	1131	071277
	16 079N	132 292E	1204	071277
	16 085N	132 292E	1231	071277
	16 094N	132 293E	1301	071277
	16 106N	132 294E	1331	071277
	16 113N	132 295E	1359	071277

EVENT	LATITUDE	LONGITUDE	TIME (ZULU)	DATE
	16 113N	132 295E	1403	071277
	16 129N	132 301E	1432	071277
	16 135N	132 303E	1505	071277
	16 149N	132 308E	1530	071277
	16 157N	132 311E	1554	071277
	16 165N	132 315E	1620	071277
	16 178N	132 321E	1701	071277
	16 183N	132 324E	1718	071277
	16 190N	132 327E	1738	071277
	16 198N	132 330E	1801	071277
	16 207N	132 334E	1831	071277
	16 216N	132 339E	1901	071277
	16 222N	132 342E	1922	071277
	16 235N	132 346E	2001	071277
	16 245N	132 350E	2031	071277
	16 254N	132 354E	2101	071277
	16 264N	132 358E	2131	071277
	16 274N	132 361E	2201	071277
	16 285N	132 362E	2231	071277
	16 296N	132 363E	2301	071277
	16 303N	132 364E	2328	071277
	16 299N	132 364E	2347	071277
	16 293N	132 360E	0001	081277
	16 284N	132 348E	0031	081277
	16 271N	132 332E	0114	081277
	16 265N	132 325E	0131	081277
	16 255N	132 314E	0201	081277
	16 250N	132 307E	0218	081277
	16 247N	132 302E	0231	081277
	16 239N	132 290E	0301	081277
	16 235N	132 286E	0314	081277
	16 230N	132 279E	0330	081277
	16 226N	132 275E	0342	081277
	16 219N	132 265E	0406	081277
	16 213N	132 256E	0430	081277
	16 204N	132 244E	0500	081277
	16 197N	132 235E	0526	081277
	16 188N	132 221E	0601	081277
	16 180N	132 211E	0631	081277
	16 179N	132 208E	0642	081277
	16 172N	132 201E	0701	081277
	16 164N	132 191E	0731	081277
	16 156N	132 181E	0801	081277
	16 148N	132 171E	0830	081277
	16 141N	132 159E	0901	081277
	16 133N	132 149E	0931	081277
	16 125N	132 139E	1001	081277
	16 118N	132 128E	1031	081277
	16 110N	132 118E	1101	081277
	16 108N	132 115E	1112	081277
	16 103N	132 107E	1131	081277
	16 095N	132 098E	1201	081277
	16 089N	132 089E	1227	081277

EVENT	LATITUDE	LONGITUDE	TIME (ZULU)	DATE
	16 076N	132 071E	1321	081277
	16 067N	132 059E	1401	081277
	16 059N	132 050E	1440	081277
	16 053N	132 042E	1501	081277
	16 047N	132 036E	1530	081277
	16 039N	132 026E	1601	081277
	16 035N	132 020E	1624	081277
	16 029N	132 012E	1652	081277
	16 020N	132 001E	1731	081277
	16 013N	131 593E	1801	081277
	16 009N	131 589E	1816	081277
	16 003N	131 583E	1840	081277
	15 599N	131 576E	1901	081277
	15 591N	131 568E	1931	081277
	15 584N	131 559E	2002	081277
	15 578N	131 549E	2031	081277
	15 571N	131 540E	2101	081277
	15 563N	131 532E	2135	081277
	15 556N	131 525E	2201	081277
	15 549N	131 518E	2231	081277
	15 541N	131 508E	2301	081277
	15 534N	131 498E	2331	081277
	15 526N	131 489E	0001	091277
	15 522N	131 485E	0018	091277
	15 518N	131 480E	0031	091277
	15 510N	131 471E	0101	091277
	15 501N	131 460E	0131	091277
	15 492N	131 449E	0206	091277
	15 485N	131 441E	0226	091277
	15 475N	131 428E	0301	091277
	15 471N	131 424E	0316	091277
26365 ►	15 467N	131 417E	0331	091277
	15 455N	131 405E	0408	091277
	15 445N	131 393E	0438	091277
	15 438N	131 384E	0501	091277
	15 426N	131 371E	0536	091277
	15 417N	131 360E	0601	091277
	15 410N	131 352E	0624	091277
	15 399N	131 339E	0701	091277
	15 394N	131 328E	0720	091277
	15 381N	131 310E	0801	091277
	15 372N	131 298E	0831	091277
	15 363N	131 284E	0901	091277
	15 352N	131 271E	0931	091277
	15 342N	131 258E	0959	091277
SE24175R ►	15 338N	131 257E	1015	091277
	15 360N	131 272E	1200	091277
	15 366N	131 276E	1233	091277
	15 377N	131 290E	1348	091277
	15 387N	131 300E	1442	091277
	15 395N	131 309E	1532	091277
	15 404N	131 313E	1604	091277
	15 412N	131 317E	1630	091277

EVENT	LATITUDE	LONGITUDE	TIME (ZULU)	DATE
	15 434N	131 327E	1750	091277
	15 453N	131 338E	1854	091277
	15 482N	131 353E	2031	091277
	15 504N	131 364E	2131	091277
	15 531N	131 395E	2324	091277
	15 557N	131 424E	0110	101277
	15 574N	131 442E	0226	101277
	15 584N	131 451E	0316	101277
	15 591N	131 456E	0350	101277
	15 596N	131 460E	0414	101277
	16 004N	131 467E	0504	101277
	16 007N	131 472E	0534	101277
	16 013N	131 479E	0614	101277
	16 022N	131 499E	0800	101277
	16 036N	131 517E	0951	101277
	16 053N	131 538E	1108	101277
	16 072N	131 554E	1231	101277
	16 090N	131 574E	1354	101277
	16 101N	131 584E	1442	101277
	16 115N	131 598E	1540	101277
	16 129N	132 009E	1628	101277
	16 137N	132 016E	1700	101277
	16 147N	132 030E	1748	101277
	16 167N	132 056E	1934	101277
	16 185N	132 073E	2101	101277
	16 210N	132 099E	2301	101277
	16 228N	132 116E	0014	111277
	16 238N	132 124E	0059	111277
	16 224N	132 137E	0140	111277
	16 218N	132 139E	0204	111277
	16 208N	132 142E	0228	111277
	16 191N	132 148E	0324	111277
	16 176N	132 154E	0414	111277
	16 165N	132 157E	0446	111277
	16 159N	132 160E	0507	111277
	16 164N	132 163E	0531	111277
	16 169N	132 169E	0601	111277
	16 175N	132 179E	0636	111277
	16 180N	132 181E	0655	111277
	16 203N	132 172E	0800	111277
	16 275N	132 222E	1156	111277
SE27000R →	16 293N	132 232E	1253	111277
	16 259N	132 177E	1450	111277
27100 →	16 266N	132 181E	1522	111277
	16 266N	132 188E	1536	111277
	16 257N	132 234E	1602	111277
	16 232N	132 337E	1702	111277
	16 209N	132 438E	1800	111277
	16 182N	132 549E	1902	111277
	16 156N	133 054E	2002	111277
	16 132N	133 159E	2102	111277
	16 109N	133 262E	2202	111277
	16 087N	133 361E	2302	111277

EVENT	LATITUDE	LONGITUDE	TIME (ZULU)	DATE
	16 063N	133 442E	0004	121277
	16 037N	133 553E	0106	121277
	16 011N	134 037E	0236	121277
	15 594N	134 173E	0320	121277
	15 582N	134 235E	0358	121277
	15 555N	134 342E	0508	121277
	15 538N	134 414E	0550	121277
	15 505N	134 540E	0707	121277
	15 495N	134 576E	0730	121277
	15 479N	135 036E	0807	121277
	15 450N	135 130E	0907	121277
	15 424N	135 224E	1007	121277
	15 403N	135 312E	1102	121277
	15 375N	135 423E	1207	121277
	15 357N	135 495E	1250	121277
	15 327N	136 018E	1402	121277
	15 310N	136 090E	1446	121277
	15 301N	136 126E	1507	121277
	15 295N	136 153E	1524	121277
	15 286N	136 196E	1550	121277
	15 271N	136 267E	1632	121277
	15 253N	136 332E	1710	121277
	15 228N	136 434E	1807	121277
	15 202N	136 530E	1904	121277
	15 171N	137 037E	2007	121277
	15 142N	137 136E	2107	121277
	15 115N	137 236E	2207	121277
	15 087N	137 335E	2307	121277
	15 061N	137 437E	0007	131277
	15 035N	137 536E	0107	131277
	15 017N	138 004E	0146	131277
	15 008N	138 040E	0207	131277
	14 599N	138 072E	0228	131277
	14 581N	138 139E	0310	131277
	14 571N	138 178E	0334	131277
	14 558N	138 234E	0407	131277
	14 538N	138 330E	0507	131277
	14 513N	138 461E	0622	131277
	14 496N	138 536E	0708	131277
	14 473N	139 030E	0808	131277
	14 451N	139 126E	0908	131277
	14 428N	139 224E	1008	131277
	14 402N	139 326E	1108	131277
	14 376N	139 429E	1208	131277
	14 356N	139 545E	1308	131277
	14 336N	140 044E	1408	131277
	14 319N	140 121E	1500	131277
	14 287N	140 236E	1608	131277
	14 257N	140 352E	1708	131277
	14 230N	140 455E	1808	131277
	14 205N	140 555E	1908	131277
	14 180N	141 057E	2008	131277
	14 155N	141 156E	2108	131277

EVENT	LATITUDE	LONGITUDE	TIME (ZULU)	DATE
	14 130N	141 254E	2208	131277
	14 102N	141 360E	2316	131277
	14 080N	141 447E	0008	141277
	14 056N	141 551E	0108	141277
	14 031N	142 053E	0208	141277
	14 016N	142 109E	0244	141277
	14 006N	142 150E	0308	141277
	13 583N	142 249E	0406	141277
	13 554N	142 352E	0506	141277
	13 526N	142 452E	0606	141277
	13 503N	142 559E	0708	141277
	13 484N	143 059E	0803	141277
	13 459N	143 159E	0903	141277
	13 435N	143 264E	1003	141277
	13 412N	143 354E	1056	141277
	13 405N	143 386E	1113	141277

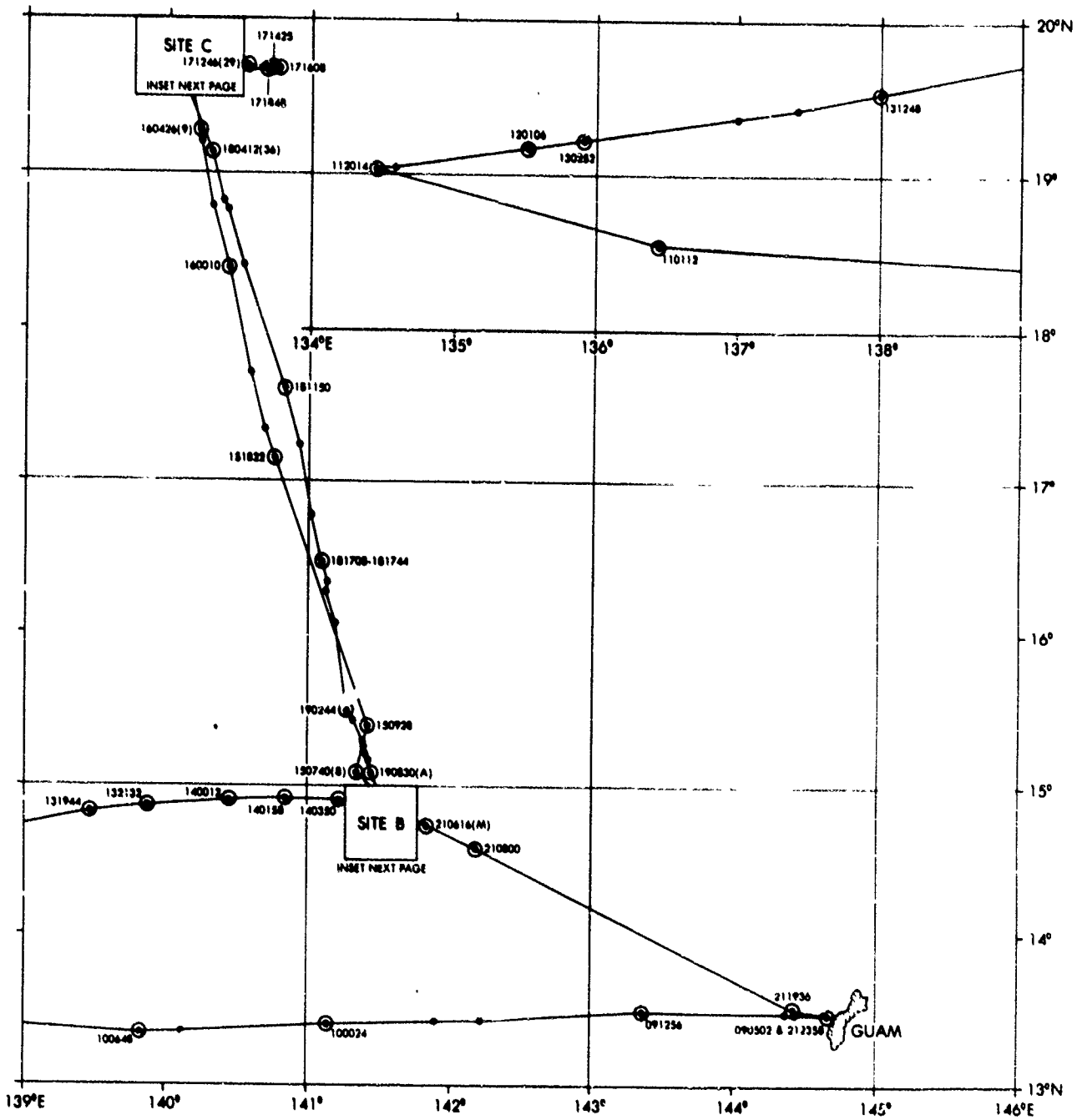
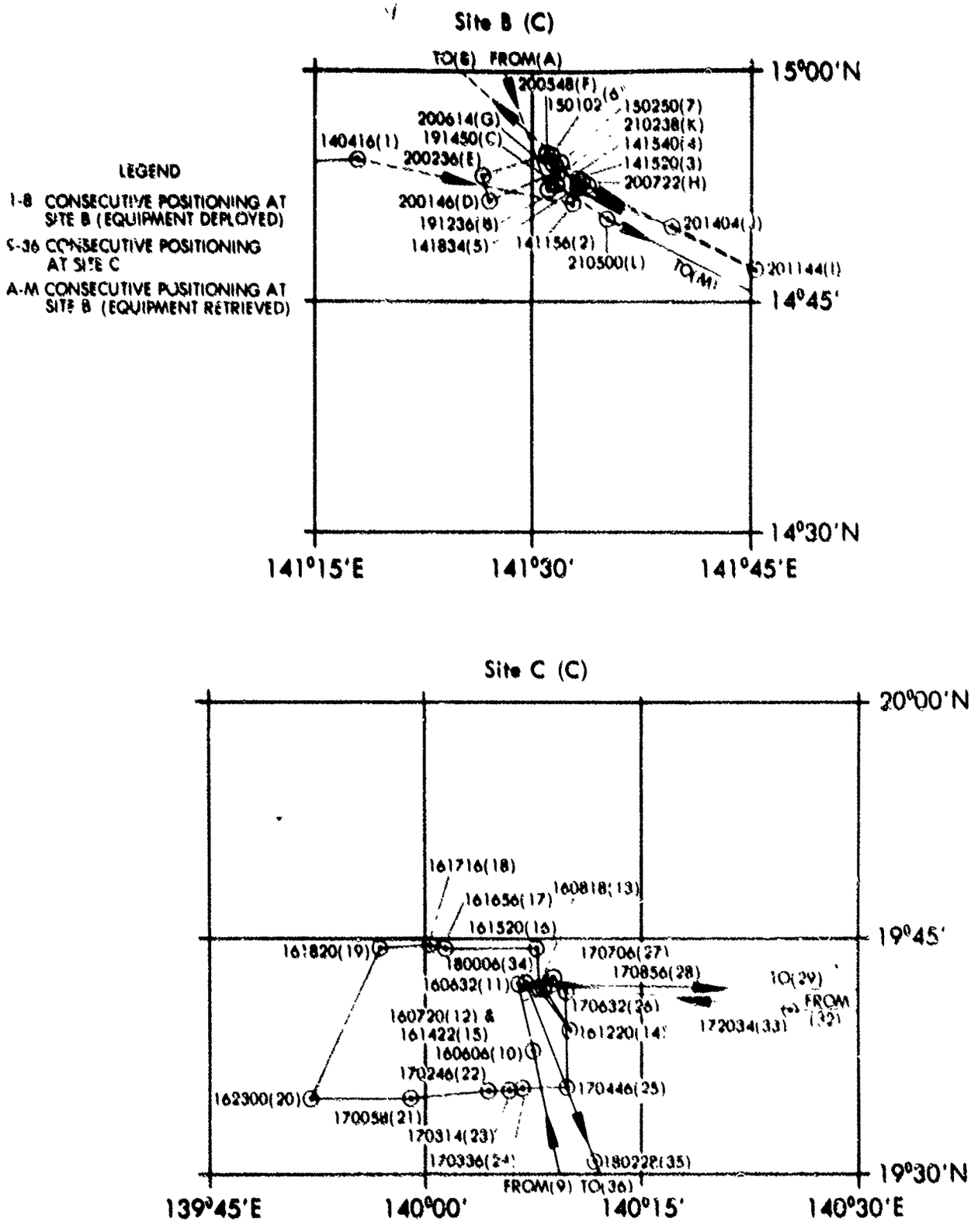


Figure 17 (C). Plot of M/V INDIAN SEAL Phase 1 rectified navigation (U)



Inset to Figure 17 (U)

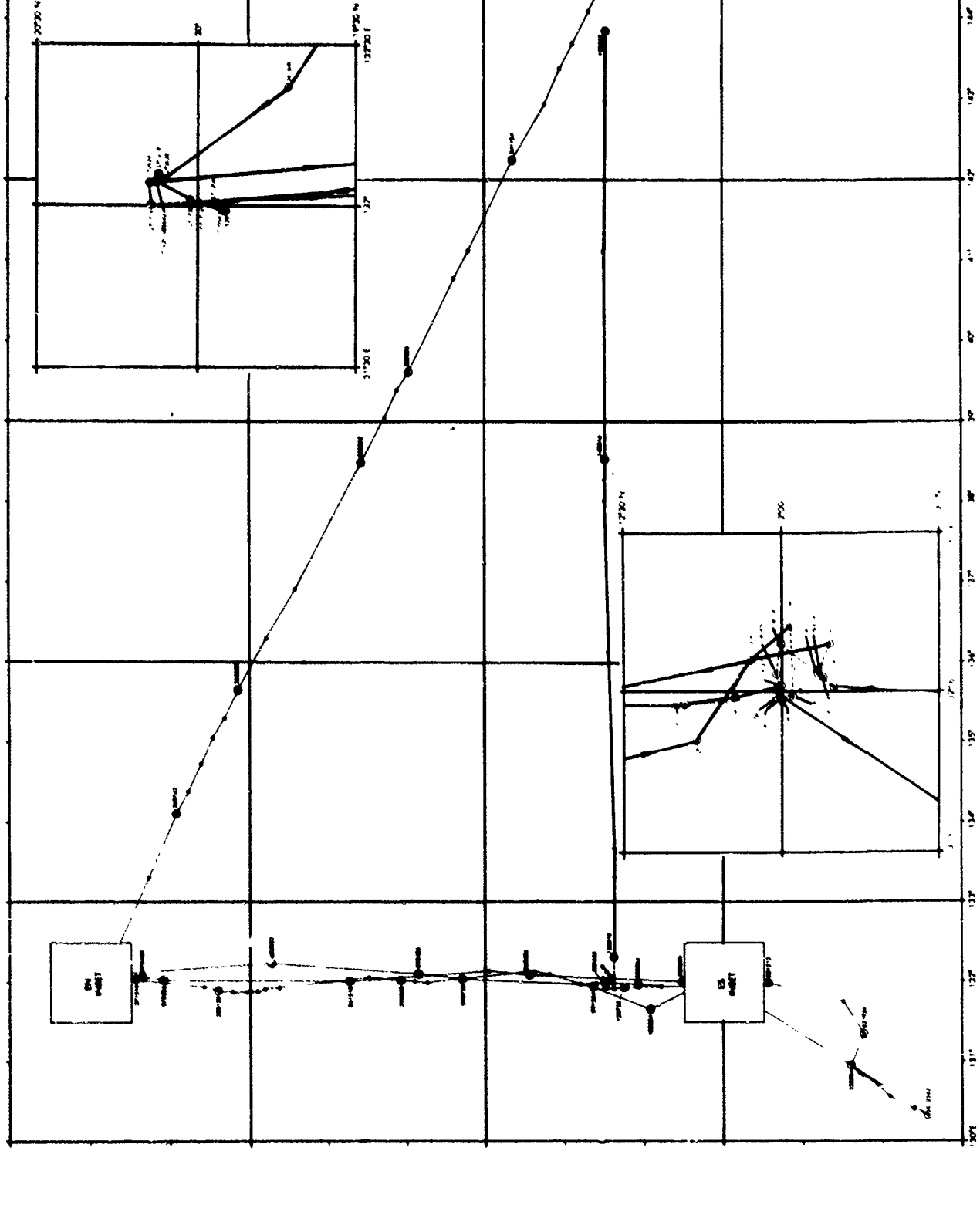


Figure 18 (C). Plot of M/V INDIAN SEAL Phase 2 rectified navigation (U)

TABLE 2 (C)

TABULATION OF RECTIFIED NAVIGATION POSITIONS FOR M/V INDIAN SEAL (U)

EVENT	LATITUDE	LONGITUDE	TIME (ZULU)	DATE
	13 277N	144 396E	0502	091177
10000	13 282N	144 257E	0720	091177
	13 281N	144 218E	0740	091177
	13 292N	143 213E	1256	091177
	13 256N	142 126E	1856	091177
	13 254N	141 533E	2040	091177
	13 242N	141 079E	0024	101177
	13 212N	140 068E	0524	101177
	13 209N	139 497E	0648	101177
	13 323N	136 269E	0112	111177
	14 023N	134 272E	2014	111177
	14 036N	134 354E	2050	111177
	14 112N	135 315E	0106	121177
	14 143N	135 550E	0252	131177
	14 271N	137 008E	0758	131177
	14 267N	137 257E	0958	131177
	14 330N	138 096E	1248	131177
	14 493N	139 287E	1944	131177
	14 518N	139 525E	2132	131177
	14 540N	140 266E	0012	141177
	14 545N	140 500E	0158	141177
	14 540N	141 127E	0350	141177
	14 541N	141 180E	0416	141177
10100	14 514N	141 327E	1156	141177
	14 528N	141 333E	1920	141177
	14 530N	141 331E	1540	141177
	14 524N	141 330E	1834	141177
	14 545N	141 312E	0102	151177
	14 541N	141 319E	0250	151177
11000	15 046N	141 195E	0740	151177
	15 233N	141 242E	0928	151177
	17 091N	140 441E	1822	151177
	17 203N	140 406E	1916	151177
	17 426N	140 348E	2104	151177
	18 236N	140 255E	0010	161177
	18 527N	140 180E	0222	161177
	19 123N	140 132E	0404	161177
	19 163N	140 126E	0426	161177
11100	19 378N	140 076E	0606	161177
	19 421N	140 065E	0632	161177
12000	19 418N	140 079E	0720	161177
	19 419N	140 082E	0818	161177
	19 392N	140 101E	1220	161177
	19 418N	140 079E	1422	161177
	19 444N	140 079E	1520	161177
	19 444N	140 015E	1656	161177
	19 445N	140 006E	1716	161177
	19 444N	139 569E	1820	161177
	19 348N	139 521E	2300	161177
	19 348N	139 590E	0058	171177
	19 353N	140 044E	0246	171177
	19 353N	140 059E	0314	171177
	19 355N	140 068E	0336	171177
	19 355N	140 098E	0446	171177
	19 416N	140 097E	0632	171177
	19 425N	140 088E	0706	171177
12050	19 420N	140 086E	0856	171177
	19 417N	140 324E	1246	171177
	19 409N	140 426E	1428	171177
	19 411N	140 456E	1608	171177
	19 405N	140 430E	1848	171177
	19 405N	140 252E	2034	171177
12100	19 422N	140 070E	0006	181177
	19 307N	140 118E	0228	181177
	19 085N	140 181E	0412	181177
	18 499N	140 226E	0542	181177
	18 463N	140 245E	0602	181177
	18 243N	140 314E	0750	181177
	17 364N	140 489E	1450	181177
	17 145N	140 551E	1502	181177
	16 469N	141 008E	1538	181177
	16 286N	141 048E	1708	181177
	16 285N	141 048E	1728	181177
	16 280N	141 050E	1744	181177
	16 205N	141 069E	1852	181177
	16 166N	141 068E	1926	181177
	16 043N	141 106E	2114	181177
	15 295N	141 181E	0244	191177
	15 257N	141 189E	0322	191177
	15 172N	141 222E	0450	191177
	15 152N	141 229E	0510	191177
	15 128N	141 237E	0535	191177
	15 099N	141 249E	0638	191177
	15 048N	141 260E	0830	191177
	14 523N	141 310E	1236	191177
12200	14 534N	141 317E	1450	191177
	14 516N	141 270E	0146	201177
	14 532N	141 265E	0236	201177
	14 545N	141 309E	0548	201177
	14 539N	141 312E	0614	201177
	14 525N	141 338E	0722	201177
	14 472N	141 453E	1144	201177
	14 500N	141 396E	1404	201177
16000	14 527N	141 316E	0238	211177
16100	14 504N	141 351E	0500	211177
	14 437N	141 407E	0616	211177
	14 346N	142 101E	0800	211177
	13 301N	144 253E	1936	211177
	13 276N	144 400E	2258	211177
	13 277N	144 400E	2132	231177
20220	13 344N	144 199E	0140	241177
	13 414N	144 054E	0248	241177
	13 536N	143 412E	0440	241177
	14 032N	143 227E	0606	241177
	14 143N	142 559E	0812	241177
	14 294N	142 145E	1134	241177

EVENT	LATITUDE	LONGITUDE	TIME (ZULU)	DATE
20220	15 127N	141 088E	1732	241177
	15 248N	140 461E	1946	241177
	15 595N	139 366E	0206	251177
	16 072N	139 225E	0344	251177
	16 171N	139 035E	0518	251177
	16 351N	136 294E	0852	251177
	17 263N	136 548E	1704	251177
	17 479N	136 189E	2026	251177
	18 095N	135 394E	2350	251177
	18 196N	135 191E	0134	261177
	18 279N	135 030E	0254	261177
	18 378N	134 436E	0430	261177
	18 476N	134 234E	0616	261177
	18 555N	134 062E	0742	261177
	19 160N	133 181E	1134	261177
261800	19 422N	132 218E	1640	261177
262215	20 064N	132 050E	0038	271177
	20 072N	132 058E	0218	271177
22000	20 091N	132 039E	0634	271177
	20 087N	132 004E	0716	271177
22070	19 253N	132 024E	1510	271177
	18 349N	131 561E	2344	271177
	18 235N	131 546E	0130	281177
	18 126N	131 527E	0312	281177
	18 014N	131 525E	0500	281177
	17 582N	131 527E	0532	281177
	17 532N	131 529E	0624	281177
	17 484N	131 535E	0714	281177
	17 377N	131 559E	0900	281177
	16 291N	132 028E	2036	281177
	16 047N	132 013E	0038	291177
22445	15 543N	132 004E	0222	291177
	15 445N	131 597E	0408	291177
	14 267N	132 075E	1650	291177
	14 239N	132 072E	1726	291177
	14 217N	132 071E	1746	291177
	14 119N	132 054E	1926	291177
	13 481N	131 588E	2342	291177
	13 361N	131 598E	0124	301177
	13 292N	131 599E	0258	301177
	13 046N	131 584E	0834	301177
	12 473N	131 562E	1126	301177
	12 181N	131 575E	1630	301177
22700	12 088N	131 589E	1820	301177
22750	11 599N	132 010E	0032	011277
	11 597N	131 581E	0418	011277
	12 004N	131 593E	0546	011277
23000	9 260N	130 199E	2342	011277
	9 364N	130 238E	0124	021277
	9 546N	130 338E	0320	021277
	10 040N	130 419E	0444	021277
	10 154N	130 500E	0620	021277
	10 180N	130 522E	0646	021277

EVENT	LATITUDE	LONGITUDE	TIME (ZULU)	DATE
	10 240N	130 570E	0804	021277
	10 149N	131 210E	1936	021277
	10 299N	131 456E	0244	031277
	11 267N	131 597E	1212	031277
	11 501N	132 008E	1714	031277
	12 001N	132 090E	0342	041277
	12 009N	132 028E	0450	041277
	11 599N	131 991E	0738	041277
	11 518N	132 027E	1514	041277
	11 534N	132 037E	1912	041277
	11 526N	132 047E	0028	051277
	11 509N	132 087E	0252	051277
	12 305N	132 006E	0630	051277
24050	13 304N	132 027E	1954	051277
	14 164N	132 050E	0356	061277
	14 569N	132 074E	0708	061277
	16 439N	132 004E	1518	061277
	19 060N	132 025E	0306	071277
24450	19 205N	132 033E	0430	071277
25000	19 561N	132 009E	1206	071277
	19 545N	131 586E	1528	071277
	19 552N	131 585E	1554	071277
	19 595N	132 006E	1716	071277
	20 014N	132 011E	1738	071277
26000	20 079N	132 045E	1920	071277
	20 074N	132 046E	0642	081277
26100	17 431N	132 146E	2002	081277
26365	15 511N	132 060E	0436	091277
	15 177N	132 011E	0722	091277
	13 484N	131 578E	1444	091277
	13 386N	131 569E	1534	091277
27150	12 555N	131 399E	0534	101277
	12 158N	131 508E	1930	101277
	12 058N	132 059E	0326	111277
28000	11 582N	132 124E	1538	111277
	11 579N	131 592E	1822	111277
28050	12 199N	131 573E	0318	121277
	13 153N	131 565E	0732	121277
	13 306N	131 546E	1248	121277
	13 240N	132 042E	1446	121277
	13 315N	132 116E	1632	121277
	13 281N	132 071E	1724	121277
	13 222N	131 546E	1900	121277
	13 229N	132 188E	0010	131277
	13 226N	133 194E	0456	131277
	13 221N	133 403E	0622	131277
	13 270N	136 070E	1756	131277
	13 296N	138 003E	0244	141277
	13 297N	138 160E	0404	141277
	13 296N	138 317E	0516	141277
28220	13 303N	141 066E	1716	141277
	13 298N	142 590E	0154	151277
	13 286N	143 507E	0552	151277
28300				

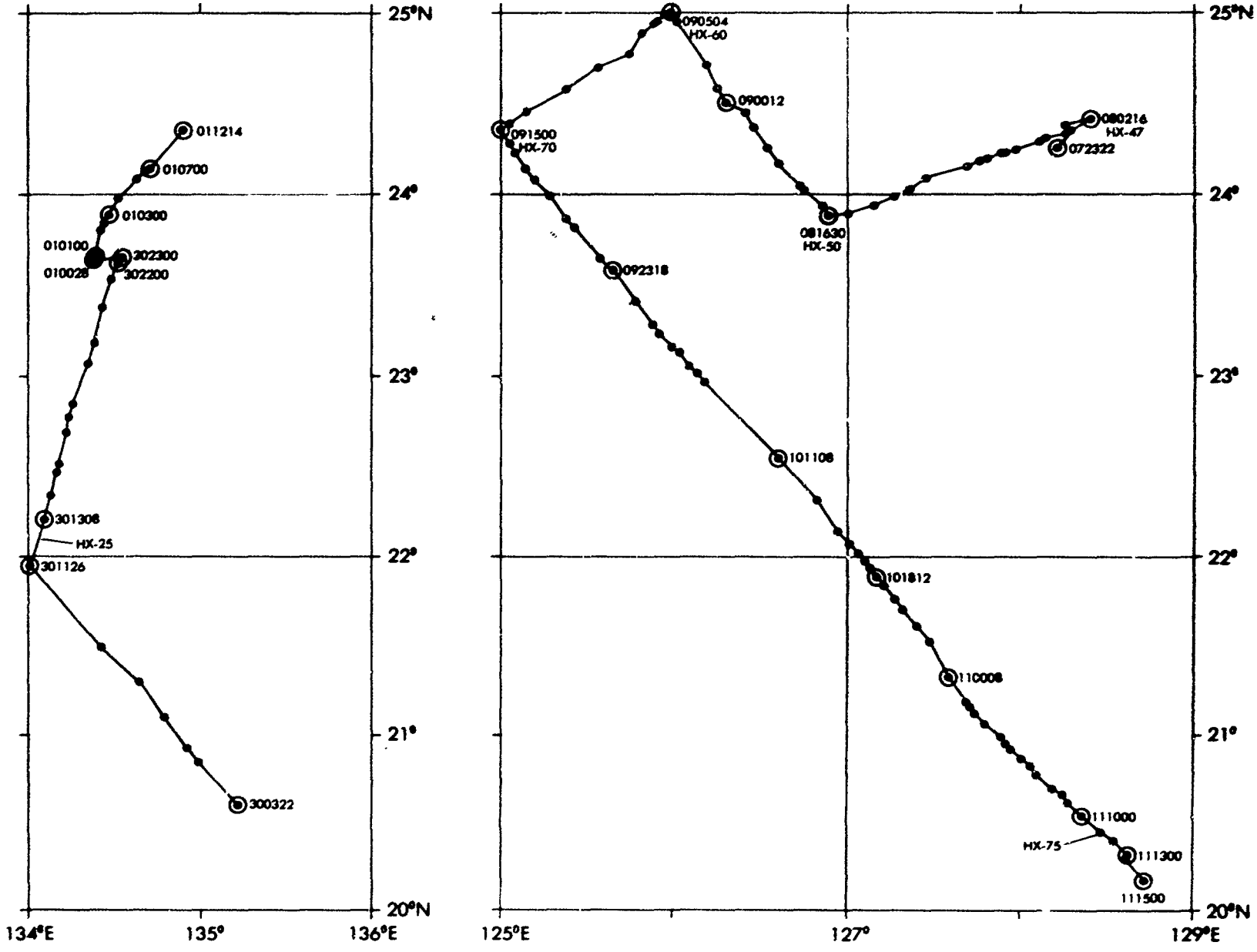


Figure 19 (C). Plot of USS BEAUFORT rectified navigation (U)

TABLE 3 (C)

TABULATION OF RECTIFIED NAVIGATION POSITIONS FOR USS BEAUFORT (U)

EVENT	LATITUDE	LONGITUDE	TIME (ZULU)	DATE
	20 360N	135 131E	0322	301177
	20 507N	134 597E	0444	301177
	20 557N	134 557E	0510	301177
	21 058N	134 478E	0600	301177
	21 179N	134 386E	0700	301177
	21 295N	134 252E	0830	301177
22450	21 568N	134 003E	1126	301177
	22 124N	134 051E	1308	301177
	22 209N	134 076E	1400	301177
	22 281N	134 097E	1446	301177
	22 305N	134 103E	1500	301177
	22 413N	134 130E	1604	301177
	22 465N	134 139E	1634	301177
	22 510N	134 152E	1700	301177
	23 040N	134 207E	1822	301177
	23 110N	134 230E	1900	301177
	23 226N	134 256E	2008	301177
	23 322N	134 289E	2100	301177
	23 372N	134 311E	2200	301177
	23 393N	134 326E	2300	301177
	23 380N	134 224E	0028	011277
22790	23 398N	134 231E	0100	011277
	23 481N	134 257E	0216	011277
	23 504N	134 264E	0236	011277
	23 532N	134 282E	0300	011277
	23 589N	134 311E	0352	011277
	24 050N	134 379E	0500	011277
	24 074N	134 404E	0600	011277
	24 088N	134 420E	0700	011277
	24 387N	134 540E	1214	011277
	24 154N	128 117E	2322	071277
	24 210N	128 167E	0100	081277
	24 228N	128 144E	0106	081277
	24 246N	128 232E	0216	081277
	24 202N	128 146E	0402	081277
	24 182N	128 082E	0458	081277
	24 173N	128 056E	0524	081277
	24 149N	127 571E	0634	081277
	24 137N	127 540E	0700	081277
	24 135N	127 526E	0714	081277
	24 114N	127 478E	0800	081277
	24 112N	127 447E	0822	081277
	24 089N	127 410E	0900	081277
	24 054N	127 267E	1112	081277
	24 017N	127 214E	1200	081277
	23 594N	127 153E	1300	081277
	23 568N	127 085E	1400	081277
	23 537N	127 000E	1500	081277
23800	23 528N	126 535E	1630	081277
	23 564N	126 512E	1712	081277
	24 015N	126 447E	1820	081277
	24 031N	126 430E	1838	081277
	24 099N	126 360E	2000	081277

EVENT	LATITUDE	LONGITUDE	TIME (ZULU)	DATE
	24 155N	126 318E	2100	081277
	24 219N	126 272E	2200	081277
	24 272N	126 243E	2300	081277
	24 305N	126 176E	0012	091277
	24 353N	126 144E	0100	091277
	24 426N	126 109E	0200	091277
	24 570N	126 001E	0414	091277
	24 591N	125 582E	0440	091277
24100	25 007N	125 581E	0504	091277
	24 592N	125 563E	0530	091277
	24 570N	125 538E	0600	091277
	24 561N	125 526E	0622	091277
	24 529N	125 484E	0712	091277
	24 458N	125 439E	0820	091277
	24 418N	125 335E	1000	091277
	24 346N	125 220E	1200	091277
	24 272N	125 087E	1346	091277
	24 234N	125 026E	1436	091277
24200	24 215N	124 597E	1500	091277
	24 162N	125 025E	1558	091277
	24 136N	125 045E	1622	091277
	24 083N	125 090E	1712	091277
	24 049N	125 118E	1748	091277
	23 589N	125 166E	1852	091277
	23 516N	125 224E	2000	091277
	23 491N	125 255E	2040	091277
	23 386N	125 343E	2200	091277
	23 349N	125 387E	2318	091277
	23 249N	125 468E	0104	101277
	23 172N	125 529E	0226	101277
	23 144N	125 547E	0252	101277
	23 099N	125 592E	0348	101277
	23 080N	126 014E	0412	101277
	23 038N	126 052E	0502	101277
	23 010N	126 077E	0534	101277
	22 579N	126 101E	0608	101277
	22 330N	126 358E	1108	101277
	22 189N	126 493E	1350	101277
	22 087N	126 569E	1534	101277
	22 044N	127 007E	1622	101277
	22 014N	127 037E	1654	101277
	21 584N	127 060E	1724	101277
	21 561N	127 078E	1746	101277
	21 534N	127 099E	1812	101277
	21 505N	127 124E	1842	101277
	21 458N	127 162E	1930	101277
	21 426N	127 190E	2000	101277
	21 369N	127 240E	2100	101277
	21 317N	127 287E	2200	101277
	21 199N	127 351E	0008	111277
	21 118N	127 405E	0138	111277
	21 099N	127 421E	0200	111277
	21 079N	127 435E	0226	111277

EVENT	LATITUDE	LONGITUDE	TIME (ZULU)	DATE
	21 039N	127 475E	0300	111277
	21 009N	127 525E	0408	111277
	20 576N	127 540E	0444	111277
	20 555N	127 562E	0506	111277
	20 522N	128 000E	0558	111277
	20 503N	128 031E	0632	111277
	20 466N	128 055E	0700	111277
	20 419N	128 110E	0800	111277
	20 401N	128 143E	0834	111277
	20 372N	128 165E	0900	111277
25250 ►	20 326N	128 219E	1000	111277
	20 270N	128 281E	1100	111277
	20 244N	128 322E	1154	111277
27080 ►	20 191N	128 379E	1300	111277
	20 165N	128 362E	1340	111277
	20 109N	128 433E	1500	111277

DISTRIBUTION LIST

Addressee	No. of Copies
Assistant Secretary of the Navy (Research, Eng. and Systems) Department of the Navy Washington, DC 20350 ATTN: G. A. Cann	1
Chief of Naval Operations Department of the Navy Washington, DC 20350	
ATTN: OP-02	1
OP-03	1
OP-05	1
OP-094	1
OP-095	1
OP-095E	1
OP-096	1
OP-951	1
OP-952	1
OP-951F	1
Headquarters Naval Material Command Washington, DC 20360 ATTN: Code MAT-08T245	2
Project Manager Antisubmarine Warfare System Project Department of the Navy Washington, DC 20360 ATTN: PM-4	2
Director Strategic System Projects Office Department of the Navy Washington, D C 20376 ATTN: PM-1	1
Chief of Naval Research 800 North Quincy Street Arlington, VA 22217	
ATTN: Code 100	1
Code 102B	1
Code 220	1
Code 230	1
Code 460	1
Code 480	1

Addressee	No. of Copies
Commander Naval Electronic Systems Command Naval Electronic SYS Command Hdqrs Washington, DC 20360	
ATTN: PME-124	1
PME-124TA	1
PME-124/30	1
PME-124/40	1
PME-124/60	1
ELEX-320	1
Commander Naval Sea Systems Command Naval Sea Systems Command Hdqrs Washington, DC 20362	
ATTN: NSEA-06HI	1
Commander Naval Air Systems Command Naval Air Systems Command Hdqrs Washington, DC 20361	
ATTN: NAIR-370	1
PMA-264	1
Deputy Under Sec of Defense For Research and Engineering Department of Defense Washington, DC 20301	1
Defense Adv Research Proj Agency 1400 Wilson Boulevard Arlington, VA 22209	
ATTN: R. G. Cook	1
Dr. T. Kooij	1
CDR V. E. Simmons	1
Commander Naval Oceanography Command NSTL Station, MS 39529	1
Director of Navy Laboratories Rm. 1062, Crystal Plaza Bldg 5 Department of the Navy Washington, DC 20360	1
Commander in Chief, Pac Fleet P. O. Box 3 Pearl Harbor, HI 96860	
ATTN: Code 3521	1

Addressee	No. of Copies
Commander in Chief U. S. Atlantic Fleet Norfolk, VA 23511	1
Commander Third Fleet Pearl Harbor, HI 96860 ATTN: Code N-7	2
Commander Second Fleet FPO New York, NY 09501	1
Commander Sixth Fleet FPO New York, NY 09501	1
Commander Seventh Fleet FPO San Francisco, CA 96601 ATTN: CAPT J. T. Talbert	1
Commander Fleet Air, Mediterranean Commander, Antisubmarine War Force U. S. Sixth Fleet FPO New York, NY 09521	1
Commander Submarine Forces U. S. Pacific Fleet Pearl Harbor, HI 96860	1
Commander Submarine Development Group 12 Box 70 Nav Sub Base, N London Groton, CT 06340	1
Commander Submarine Group Seven Box 50 FPO Seattle, WA 98762 ATTN: CAPT J. McNish	1
Commander Operational Test and Eval. Force Naval Base Norfolk, VA 23511	1
Commander Patrol and Reconnaissance Force Seventh Fleet FPO Seattle, WA 98768 ATTN: CDR P. O'Connor	1

Addressee	No. of Copies
Commander U. S. Naval Forces, Marianas FPO San Francisco, CA 96630 ATTN: LCDR D. L. Wethrell	1
Commander Patrol Wings U. S. Pacific Fleet Naval Air Station Moffett Field, CA 94035	1
Commander Oceanographic System, Atlantic Box 100 Norfolk, VA 23511	2
Commander Oceanographic System, Pacific Box 1390 Pearl Harbor, HI 96860	2
Commander Patrol Wing Two FPO San Francisco, CA 96601	1
Commanding Officer Fleet Numerical Weather Central Monterey, CA 93940	2
Commanding Officer Fleet Weather Central McAdie Building (U-1171) NSA Norfolk, VA 23511	1
Commanding Officer Fleet Weather Central Box 113 Pearl Harbor, HI 96860	1
Oceanographic Development Sqd 8 Naval Air Station Patuxent River, MD 20670	1
Commanding Officer Chesapeake Div Naval Facilities Eng Command Washington Navy Yard Washington, DC 20374 ATTN: Code FPO-1E4	1
ARPA Research Center Unit 1, Bldg 301A NAS Moffett Field, CA 94035 ATTN: E. L. Smith	1

Addressee	No. of Copies
Defense Documentation Center Cameron Station Alexandria, VA 22314	1
Commanding Officer Naval Research Laboratory Washington, DC 20375	
ATTN: Code 8100	1
Code 8160	1
Code 2627	1
Commanding Officer Naval Research Laboratories P. O. Box 8337 Orlando, FL 32805	1
ATTN: Code 0277	1
Code 8280	1
Code 8289	1
Commander Naval Oceanographic Office NSTL Station, MS 39522	1
ATTN: Code 3000	1
Code 3440	1
Library	1
Commanding Officer Naval Ocean Research & Development Activity NSTL Station, MS 39529	1
ATTN: Code 110	1
Code 125	1
Code 200	1
Code 300	1
Code 320	1
Code 340	1
Code 500	1
Code 520	2
Naval Ocean Research & Development Activity Liaison Office 800 North Quincy Street Arlington, VA 22217	
ATTN: Code 130	1
Officer in Charge New London Laboratory Naval Underwater Systems Center New London, CT 06320	
ATTN: Code 31	1
Code 312	1
Code 542	1

Addressee	No. of Copies
Commander Naval Ocean Systems Center San Diego, CA 92152	1
ATTN: Code 5301	2
Code 724	2
Code 7243	1
Commander Naval Air Development Center Warminster, PA 18974	
ATTN: Code 303	1
Code 3032	1
Commanding Officer Naval Coastal Systems Laboratory Panama City, FL 32407	1
Officer in Charge White Oak Laboratory Naval Surface Weapons Center Silver Spring, MD 20910	1
Officer in Charge Carderock Lab David H. Taylor Naval Ship Res & Development Center Bethesda, MD 20084	1
Director Naval Ocean Surveillance Info Cent 4301 Suitland Road Washington, DC 20390	1
Commanding Officer Naval Intelligence Support Center 4301 Suitland Road Washington, DC 20390	1
Superintendent Naval Postgraduate School Monterey, CA 93940	
ATTN: Library	1
Commanding Officer Naval Environmental Prediction Research Facility Monterey, CA 93940	1
Chief Def. Res. Est. Pacific Fleet Mail Office Canadian Forces Base Victoria, BC V0S 1B0	1
Chief Def. Res. Est. Atlantic P. O. Box 1012 Dartmouth, Nova Scotia B2Y 3Z7	1

Addressee	No. of Copies
Director of Naval Matters Center of Naval Analysis Arlington, VA 22209	1
ATTN: C. E. Woods	1
University of Hawaii Hawaii Institute of Geophysics 2525 Correa Road Honolulu, HI 96822	1
Johns Hopkins University Applied Physics Laboratory Johns Hopkins Road Laurel, MD 20810	
ATTN: A. Chwastyk	1
W. L. May	1
G. L. Smith	1
Palisades Geophysical Inst. Inc. 131 Erie Street P. O. Box 396 Blauvelt, NY 10913	1
Scripps Inst. of Oceanography Marine Physical Laboratory San Diego, CA 92152	
ATTN: Dr. V. C. Anderson	1
University of Texas Applied Research Laboratories P. O. Box 8029 Austin, TX 78712	
ATTN: G. E. Ellis	1
Dr. L. D. Hampton	1
University of Washington Applied Physics Laboratory 1018 NE Fortieth Street Seattle, WA 98195	1
Woods Hole Oceanographic Inst. Woods Hole, MA 02543	
ATTN: Dr. E. E. Hays	2
Analysis and Technology, Inc. Route 2 North Stonington, CT 06359	
ATTN: S. Elam	1
Arthur D. Little, Inc. 15 Acorn Park Cambridge, MA 02140	
ATTN: Dr. G. Raisbeck	1
W. G. Sykes	1

Addressee	No. of Copies
B-K Dynamics 15825 Shady Grove Road Rockville, MD 20850 ATTN: P. G. Bernard	1
Bell Telephone Laboratories 1 Whippany Road Whippany, NJ 07981 ATTN: Dr. J. Goldman	1
Bendix Electrodynamics, Inc. 15825 Roxford Street Sylmar, CA 91342	1
Benthos, Inc. Edgerton Drive N. Falmouth, MA 02556 ATTN: R. K. Church P. F. Smith S. O. Raymond	1 1 1
Bolt, Beranek and Newman 1701 N. Fort Myer Drive Suite 1001 Arlington, VA 22209	1
Bolt, Beranek and Newman 50 Moulton Street Cambridge, MA 02138	1
Bunker-Rand 31717 La Tienda Drive Westlake Village, CA 91361 ATTN: R. K. Fullerton	1
Claude P. Brancart & Assoc., Inc. 17150 Butte Creek Road, Suite 214 Houston, TX 77090	1
Daniel Analytical Services Corp. 16821 Buccaneer Lane Clear Lake City Houston, TX 77058 ATTN: E. D. Graham	1
Daniel H. Wagner Associates Station Square One Paoli, PA 19301	1
Daurin Systems Corp. 104 Crandon Boulevard Suite 315 Key Biscayne, FL 33149 ATTN: Dr. S. C. Daupin	1

Addressee	No. of Copies
Envo, Inc. 800 Follin Lane Vienna, VA 22180 ATTN: G. A. Phillips	1
General Electric Corp. Farrell Road Plant Syracuse, NY 13201 ATTN: K. D. Greenhalgh	1
General Electric Corp. Reentry Envir. Sys. Div. 3198 Chestnut Street Philadelphia, PA 19101 ATTN: O. Klima Dr. E. L. Murphy	1 1
Gould, Inc. Chesapeake Instrument Div. 6711 Baymeadow Drive Glen Burnie, MD 21061 ATTN: K. Smith	1
Lockheed Missiles and Space Company, Inc. P. O. Box 504 Sunnyvale, CA 94088 ATTN: R. C. Parsons	1
Magnavox, Inc. 2829 Maricopa Street Torrance, CA 90503 ATTN: N. P. Raimondo	1
Ocean Data Systems, Inc. 6000 Executive Boulevard Rockville, MD 20852 ATTN: G. V. Jacobs Dr. E. Morenoff E. W. Verhoff	1 1 1
Ocean Data Systems, Inc. 2400 Garden Road Monterey, CA 93940	1
Ocean Data Systems, Inc. 3255 Ming Street, Suite 550 San Diego, CA 92110	
Operations Research, Inc. 1400 Spring Street Silver Springs, MD 20910 ATTN: Dr. J. I. Bowen	1

Addressee	No. of Copies
Planning Systems, Inc. 7900 Westpark Drive, Suite 600 McLean, VA 22101 ATTN: R. Klinkner	1
Dr. L. P. Solomon	1
Purvis Systems, Inc. 3420 Kenyon St., Suite 130 San Diego, CA 92110 ATTN: T. J. Fitzgerald	1
Raytheon Company Submarine Signal Division P. O. Box 360 Portsmouth, RI 02871 ATTN: Dr. B. A. Becken	1
Sanders Associates, Inc. 95 Canal Street Nashua, NH 03060 ATTN: L. E. Gagne	1
R. P. White	1
Science Applications, Inc. 8400 Westpark Drive McLean, VA 22101 ATTN: Dr. J. S. Hanna	1
C. W. Spofford	1
Spectral Dynamics Corp. 8835 Balboa Avenue P. O. Box 671 San Diego, CA 92112 ATTN: B. Ycungberg	1
Summit Research Corp. 1 West Deer Park Drive Gaithersburg, MD 20760	1
Sutron Corp. 1925 N. Lynn Street, Suite 700 Arlington, VA 22209 ATTN: C. H. Dahney	1
Systems Integrated 1451 Irvine Blvd., Suite 24 Tustin, CA 92680 ATTN: L. Pomatto	1
Tetra Tech,, Inc. 1911 Fort Meyer Drive Arlington, VA 22209	1

Addressee	No. of Copies
Texas Instruments, Inc. P. O. Box 226015 Dallas, TX 75266 ATTN: A. Kirst, Jr.	2
Tracor, Inc. 1601 Research Boulevard Rockville, MD 20850 ATTN: J. T. Gottwald Dr. A. F. Wittenborn	1 1
TRW Systems Group 7600 Colshire Drive McLean, VA 22101 ATTN: R. T. Brown I. B. Gereben	1 1
Undersea Research Corp. 7777 Leesburg Pike, Suite 306 Falls Church, VA 22043 ATTN: V. F. Anderson	1
Undersea Research Corp. P. O. Box 26249 San Diego, CA 92126 ATTN: J. R. Harkness	1
Underwater Systems, Inc. 8121 Georgia Avenue Silver Spring, MD 20910 ATTN: Dr. M. S. Weinstein	1
Western Electric Company P. O. Box 25000 Greensboro, NC 27420 ATTN: G. H. Harris	1
Westinghouse Electric Company P. O. Box 1488 Mail Stop 9R40 Annapolis, MD 21404	1
Xonics, Inc. 6837 Hayvenhurst Avenue Van Nuys, CA 91406	1
Xonics, Inc. 3515 East Tuohy Des Plaines, IL 60018 ATTN: S. Kulek	1
Defense Technical Information Cameron Station Alexandria, VA 22314	2

CONFIDENTIAL

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER NORDA Technical Note 44	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) Environmental Variability During the CHURCH STROKE II Cruise 5 Exercise		5 TYPE OF REPORT & PERIOD COVERED Final 6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) Paul J. Bucca		8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS Naval Ocean Research and Development Activity NSTL Station, Mississippi 39529		10 PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS 63795N-AR0119-300-13412100
11. CONTROLLING OFFICE NAME AND ADDRESS Long Range Acoustic Propagation Project (Code 520) Naval Ocean Research and Development Activity NSTL Station, Mississippi 39529		12. REPORT DATE February 1979 13. NUMBER OF PAGES 54
14. MONITORING AGENCY NAME & ADDRESS(if different from Controlling Office)		15. SECURITY CLASS. (of this report) CONFIDENTIAL 15a. DECLASSIFICATION/DOWNGRADING SCHEDULE Classified by OPNAVINST 5513.5 (Encl. 42) Review on 31 August 1980.

16. DISTRIBUTION STATEMENT (of this Report)

Further dissemination only as directed by the Long Range Acoustic Propagation Project, NORDA Code 520.

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES

PRECEDING PAGE BLANK - NOT FILMED

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Oceanographic data
Philippine Sea
Sound speed structure
Long Range Acoustic Propagation Project (LRAPP)

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

(C) During the period from 9 November to 16 December 1977, 160 XBTs and 127 AXBTs were deployed during Cruise 5 of the CHURCH STROKE II Exercise, which took place in the Philippine Sea. Analyses of sound speed conditions along the exercise baseline (12°-20°N along 132°E) indicate that the presence of Typhoon Lucy during the exercise had only a minimal effect on the oceanographic environment, owing primarily to deep mixing resulting from three previous typhoons and one tropical storm that traversed

DD FORM 1 JAN 73 1473 EDITION OF 1 NOV 65 IS OBSOLETE
S/N 0102-014-6601

CONFIDENTIAL

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

the area in four months. The largest oceanographic variation occurred between the southern and northern extremes of the baseline in the thermocline area where a difference of 21.8 m/sec in sound speed was observed. This variability is attributed to the presence of an upwelling area centered at 7°N at approximately the same latitude as the baseline. Oceanographic variation is evaluated along an acoustic projector tow which took place on the continental shelf and trench areas of the southern Ryukyu Island arc.

DEPARTMENT OF THE NAVY
OFFICE OF NAVAL RESEARCH
875 NORTH RANDOLPH STREET
SUITE 1425
ARLINGTON VA 22203-1995

IN REPLY REFER TO:

5510/1
Ser 321OA/011/06
31 Jan 06

MEMORANDUM FOR DISTRIBUTION LIST

Subj: DECLASSIFICATION OF LONG RANGE ACOUSTIC PROPAGATION PROJECT (LRAPP) DOCUMENTS

Ref: (a) SECNAVINST 5510.36

Encl: (1) List of DECLASSIFIED LRAPP Documents

1. In accordance with reference (a), a declassification review has been conducted on a number of classified LRAPP documents.

2. The LRAPP documents listed in enclosure (1) have been downgraded to UNCLASSIFIED and have been approved for public release. These documents should be remarked as follows:

   Classification changed to UNCLASSIFIED by authority of the Chief of Naval Operations (N772) letter N772A/6U875630, 20 January 2006.

   DISTRIBUTION STATEMENT A: Approved for Public Release; Distribution is unlimited.

3. Questions may be directed to the undersigned on (703) 696-4619, DSN 426-4619.

BRIAN LINK
By direction

Subj: DECLASSIFICATION OF LONG RANGE ACOUSTIC PROPAGATION PROJECT (LRAPP) DOCUMENTS

DISTRIBUTION LIST:

NAVOCEANO (Code N121LC – Jaime Ratliff)
NRL Washington (Code 5596.3 – Mary Templeman)
PEO LMW Det San Diego (PMS 181)
DTIC-OCQ (Larry Downing)
ARL, U of Texas
Blue Sea Corporation (Dr.Roy Gaul)
ONR 32B (CAPT Paul Stewart)
ONR 321OA (Dr. Ellen Livingston)
APL, U of Washington
APL, Johns Hopkins University
ARL, Penn State University
MPL of Scripps Institution of Oceanography
WHOI
NAVSEA
NAVAIR
NUWC
SAIC

Declassified LRAPP Documents

Report Number	Personal Author	Title	Publication Source (Originator)	Pub. Date	Current Availability	Class.
Unavailable	Penrod, C. S., et al.	MOORED SURVEILLANCE SYSTEM FIELD VALIDATION TEST SENSOR PERFORMANCE ANALYSIS. VOLUME I. DATA COLLECTION AND MESUREMENT SYSTEM DESCRIPTION	University of Texas, Applied Research Laboratories	781231	ADC018009	C
Unavailable	Watkins, S. L., et al.	MOORED SURVEILLANCE SYSTEM FIELD VALIDATION TEST SENSOR PERFORMANCE ANALYSIS. VOLUME III. VERNIER RESOLUTION DATA PRODUCTS	University of Texas, Applied Research Laboratories	781231	ADC018373	C
Unavailable	Watkins, S. L., et al.	MOORED SURVEILLANCE SYSTEM FIELD VALIDATION TEST SENSOR PERFORMANCE ANALYSIS. VOLUME II. STANDARD RESOLUTION DATA PRODUCTS	University of Texas, Applied Research Laboratories	781231	ADC018374	C
NORDATN44	Bucca, P. J.	ENVIRONMENTAL VARIABILITY DURING THE CHURCH STROKE II CRUISE FIVE EXERCISE (U)	Naval Ocean R&D Activity	790201	ADC020353; NS; AU; ND	C
NADC7820830	Balonis, R. M.	TEST STEERED VERTICAL LINE ARRAY (TSVLA) MEASUREMENTS FOR BEARING STAKE SURVEYS (U)	Naval Air Systems Command	790301	ADC018003; NS; ND	C
USIControl674779	Williams, W., et al.	REPORT OF THE LRAPP EXERCISE PLANNING WORKSHOP TRACOR INC ROCKVILLE MD 16 - 17 OCTOBER 1978 (U)	Underwater Systems, Inc.	790302	NS; ND	C
NOSCTR357	Hamilton, E. L., et al.	GEOACOUSTIC MODELS OF THE SEAFLOOR: GULF OF OMAN, ARABIAN SEA, AND SOMALI BASIN (U)	Naval Ocean Systems Center	790615	ND	C
Unavailable	Unavailable	RAPIDLY DEPLOYABLE SURVEILLANCE SYST (RDSS) ACOUSTIC VALIDATION TEST (AVT) EXERCISE PLAN (U)	Naval Electronic Systems Command	790625	AU	C
LRAPPRC79027	Brunson, B. A., et al.	GULF OF MEXICO AND CARIBBEAN SEA DATA AND MODEL BASE REPORT (U)	Tracor, Inc.	790701	ADC019153; NS; ND	C
Unavailable	Unavailable	BEARING STAKE BMS DATA QUALITY ASSESSMENT REPORT (U)	University of Texas, Applied Research Laboratories	790705	AU	C
PME12430	Unavailable	RAPIDLY DEPLOYABLE SURVEILLANCE SYSTEM (RDSS) ACOUSTIC VALIDATION TEST (AVT) DATA REDUCTION AND ANALYSIS PLAN (U)	Naval Electronic Systems Command	790815	NS; AU	C
Unavailable	Unavailable	RAPIDLY DEPLOYABLE SURVEILLANCE SYSTEM (RDSS) ACOUSTIC VALIDATION TEST (AVT) EXERCISE PLAN (U)	Naval Electronic Systems Command	790917	AU	C
NOSCTR467	Pedersen, M. A., et al.	PROPAGATION LOSS ASSESSMENT OF THE BEARING STAKE EXERCISE (U)	Naval Ocean Systems Center	790928	ADC020845; NS; AU; ND	C
NOSCTR466	Anderson, A. L., et al.	BEARING STAKE ACOUSTIC ASSESSMENT (U)	Naval Ocean Systems Center	790928	ADC020797; NS; AU; ND	C